DOCUMENT RESUME

ED 062 124 24 SE 013 504

TITLE	Documentation Report, Self-Paced Physics, Course Evaluation.
INSTITUTION	Naval Academy, Annapolis, Md.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C. Bureau of Research.
BUREAU NO	BR-8-0446
PUB DATE	Sep 71
NOTE	89p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	Audiovisual Aids; College Science; Comparative Analysis; *Course Evaluation; *Individualized Instruction; *Physics; *Student Attitudes; *Student Testing
IDENTIFIERS	Self Paced Physics

ABSTRACT

A self-paced, individualized, multimedia physics course developed by the New York Institute of Technology for the U. S. Naval Academy with funds provided by the U. S. Office of Education is evaluated. Student performance is measured by "core problems." A core problem is a terminal objective in problem form. The student uses his results as a basis for choosing one of three alternatives: to proceed to the next core problem, to try the core prime problem (a variation of the core problem), or to address a sequence of enabling problems (illustrating major steps for the achievement of the core problem). In comparisons with "conventional" instruction, no achievement differences were found between the forms of instruction. However, reasons were cited which indicated that under the conditions of the experiment the self-paced students were placed at a disadvantage with respect to these criteria. It was concluded that the individualized, self-paced system makes a substantial difference in performance over conventional instruction. Included are evaluations of the media used and the cost effectiveness of the program. Extensive tables of statistical data are added as appendices. (Author/TS)

ED 062124

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY

8-044
SE
F-DOP

DOCUMENTATION REPORT

SE 013 504

Technical Report 5.9

COURSE EVALUATION

Physics Program

Submitted by the

New York Institute of Technology

Old Westbury, New York 11568

September, 1971

Developed and produced under the
U. S. Office of Education, Bureau
of Research Project #8-0446, for the
U. S. Naval Academy at Annapolis
Contract #N00600-68C-0749

COURSE EVALUATION

Table of Contents

Introduction 1

Revision Features 1

Revision Evaluation 3

Comparison With Conventional Instruction 5

Other Evaluation Measures 13

Media Evaluation 20

Cost Effectiveness 23

Table 1 6

Table 2 7

Table 3 12

Appendix A: 1970 Core and Core Prime Data

Appendix B: Problems Omitted from Final Exam

Appendix C: Final Exam Data Analysis

Appendix D: Student Questionnaire

Appendix E: Background Variables and Response Statistics

Introduction

The final revision of the Self-Paced Physics program was characterized by extensive alterations. These changes were arrived at through a systems approach using data, experience, and judgment. Our purpose here is to ascertain whether the revision process worked and, to a lesser extent, to compare the program with conventional instruction.

It has only been possible to obtain gross measures of program effectiveness since an evaluation of the installed, free-running system was not planned as part of the study. Of course, the need for evaluating the final revision could not have been anticipated at the inception, just as the many difficulties and extensive alterations were unexpected.

Although circumstances limited the possible analysis, we can state with some assurance that the revision caused an increase of over fifty percent in students reaching the criteria. Comparisons with conventional instruction are much less clear, but it appears that the system holds a substantial margin in performance on the course objectives. Before discussing the evidence for these conclusions, it is helpful to summarize some of the features of the last revision.

Revision Features

A central feature of the self-paced program is its responsiveness to immediate past performance. In the *latest* version this is accomplished primarily through performance on a core problem (a terminal objective in problem form). The student uses this as a basis for choosing one of three alternatives: to proceed to the next core problem, to try the core prime problem (a variation of the core problem), or to address a

sequence of enabling problems (illustrating major steps for the achievement of the core problem).

Thus, when a student is able to solve a core problem with confidence, he maximizes his rate by moving directly to the next objective. Some students expect that they can execute problems similar to the core after having seen the correct solution. Often, such students have made a minor error in the core and only need a similar problem for practice and reinforcement; this is provided by the core prime problem. When a student incorrectly assesses his ability to solve the core prime, or when he realizes that his understanding of the core problem is deficient, then he takes the enabling problem sequence. The core prime problem is always encountered at the end of the enabling sequence.

In preceding versions of the program, all students worked at all problems in ascending difficulty. The primary responsive agents were branches to remedial pages in the case of errors. The substantial revisions were designed to economize on students' study time, to provide advance organizers in the form of core problems, to use core prime problems as an immediate "posttest" for reinforcement and practice, to avoid emphasis on "second-guess remediation" which was unsuccessful in anticipating which one of myriad possible errors was likely to be committed, and generally to increase the possible number of learning paths for greater individualization and motivation. These are detailed in the Course Development Report and the Revision Process Report.

Other revisions were made in accord with the systems approach. Information Panels were created to orient students and provide overviews. Additional problems were created for "trouble topics."

Problem statements were revised to avoid any ambiguities, and problems which did not adequately support objectives were removed. A Study Guide was created to serve as the primary agent of internal management; it reveals answers to the student and directs his progress through alternative paths on the basis of these answers. By using Study Guides and a revised format for the Problem and Solution Books, the student was relieved of a great deal of page turning. These and many additional revision steps are presented in the Revision Process Report.

Revision Evaluation

The data available for making an evaluation of the revised program were extremely limited. Provisions were not made for data collection under controlled conditions because the delivered version was a free-running course with students progressing at their own rates and using the materials they most preferred--hardly an ideal experimental situation.

It was not possible to compare the Fall 1969 and Fall 1970 runs on the basis of test performance because the Academy faculty chose a new instrument for class grades (diagnostic tests) and constructed a new Final Examination, not at all parallel to the prior examination. The Academy was more interested in evaluation measures for midshipmen than for the program, as they should be. Even posttests were changed in content and level, and from a mandatory grade-establishing status to an optional progress check.

Only one "test" collection remained sufficiently unaltered and was administered under sufficiently similar conditions--problems from the Problem and Solution Books. Even a majority of these problems have been changed in format from multiple-choice to completion and constructed re-

sponse. This severely narrowed our potential for comparison because multiple-choice answers may be guessed, unlike constructed responses. Statistical corrections for guessing are inadequate due to the fact that many students will work until they match one of the choices, although constructed responses do not provide similar feedback. Moreover, the answer solutions are not equally probable.

There is special merit to comparing core problem performance before and after revision. The core problems represent terminal objectives and, as such, performance on these problems is the prime measure of achievement of course objectives. A straightforward comparison of core problems, however, is unwarranted because in older versions they appeared at the end of an enabling sequence, whereas now they appear before any other problems on that objective. Essentially, the core prime has taken the place of the core as the final exercise on the given objective.

Consequently, the appropriate comparison is between Fall 1969 core problems and Fall 1970 core prime problems. We found the subset of core primes which are exceptionally parallel to the original cores (usually only number changes), which are multiple choice with very parallel distractors, and which have always had the same mandatory status.

Fourteen pairs of cores and core primes satisfied all the required constraints. The results are listed in Table 1. Assuming equivalent student populations, a 57% increase in achieving criteria has been accomplished by the revised system over the 1969 version. Although the number of matched problem pairs is small, they are rather representative and well-distributed. This, and the rather uniform improve-

ment throughout the entire list, strongly suggests that the result is a good gross measure of the efficacy of the revised approach.

In recording the core prime results, any questionable response was counted as incorrect. When a student successfully completed a core problem, and proceeded to the next objective, the core prime was scored as correct.

Missing responses are not included in the calculations for comparison purposes because the 1969 computations did not include missing responses. Table 2 shows the 1970 data adjusted to treat missing responses as incorrect. This provides a more meaningful absolute measure of the percent reaching criterion, 72%, as opposed to 77% for comparative use.

Ideally, it would have been desirable to perform statistical analysis on student populations in various background variable categories. This was not possible because individual data by student by problem in the Problem and Solution Book were unavailable for the 1969 run. The assumption of equivalent populations, however, is reasonably well supported by a comparison of background variables averaged over the whole group.

Comparison With Conventional Instruction

Any assessment of "conventional" instruction is difficult because of the large variability in the person of the instructor; the classes of two different lecturers may perform quite differently. A comparison of the self-paced program with its conventional counterpart is further obfuscated, as we shall see, by several factors pertaining to the common Final Examination.

One hundred self-paced students and 114 conventional students of Physics SP211 took the uniform Final Examination in Fall 1970. With the

TABLE 1

PROBLEM NUMBER			PERCENT CORRECT	
New Core	New Prime	Old Core	1970 Core	1969 Core
1/6	1/9	1/16	79	46
2/1	2/5	1/15	92	60
4/6	4/10	4/8	90	49
4/16	4/20	4/21	85	42
5/13	5/17	5/10	59	51
7/5	7/8	7/9	80	29
7/10	7/14	7/24	64	41
7/27	7/29	7/22	58	43
8/5	8/8	8/11	65	52
8/13	8/17	8/17	68	52
9/1	9/3	9/4	86	76
11/1	11/4	11/1	92	53
11/25	11/17	11/24	93	79
13/11	13/14	13/19	66	15
		Average	77	49

TABLE 2

PROBLEM NUMBER			PERCENT CORRECT	
New Core	New Prime	Old Core	With Omissions	Without Omissions
1/6	1/9	1/16	79	79
2/1	2/5	1/15	91	92
4/6	4/10	4/8	89	90
4/16	4/20	4/21	83	85
5/13	5/17	5/10	49	59
7/5	7/8	7/9	77	80
7/10	7/14	7/24	59	64
7/27	7/29	7/22	48	58
8/5	8/8	8/11	54	65
8/13	8/17	8/17	56	68
9/1	9/3	9/4	73	86
11/1	11/4	11/1	92	92
11/15	11/17	11/24	92	93
13/11	13/14	13/19	64	66
		Average	72	77

omission of problems which were ambiguous or not related to NYIT course objectives (see Appendixes B and C for full details), both groups attained 55% averages.

Course designers point to several circumstances which may have prevented the self-paced group from a stronger relative performance. First, the total performance is very poor for all students, especially for a multiple-choice test on which random choices would score 20%. One may be immediately suspicious that the examination did not test what it intended to test, even though our specialists agree that most of the items are good problems.

If the test items were fair, then it is likely that the test conditions were different than those implied by the course objectives. Indeed, for an entire semester students were allowed to achieve objectives at their own rate, whereas it was demanded that they complete 55 problems in 3 hours on the Final Examination. Most of these problems required computation and contemplation; it took an investigator an hour just to read the problems with enough care to classify them. These considerations suggest that the Final Examination performance is, in large measure, the result of a race for which neither conventional nor self-paced students were trained.

The Final Exam was developed by concensus among the Academy faculty members. Surely no instructor would agree to the inclusion of topics which were not covered in class. This, coupled with the fact that only a fraction of the objectives was sampled, gave an advantage to those student sections which covered the least material. We know from the study guide responses that the self-paced sections covered all objectives. Thus, any conventional sections which were allowed to omit material due to its relative

"unimportance" would be able to concentrate more intensively on less material.

Self-paced students suffered other disadvantages on the Final Examination. The objectives which they worked toward in the Problem and Solution Book are primarily multiple-step (see Report TR 5.8 for details of this classification scheme). The Final Examination items, however, are primarily one-step. The correlation between one-step and multiple-step problems is .65 (TR 5.8); rot high enough to imply that a student who is performing well in one category will perform equally well in the other.

Moreover, the diagnostic tests given to the self-paced group during the semester (for grading purposes) must have adversely influenced the students. These problems were primarily zero-step. Certainly this caused a poor state of preparedness for the Final because zero-step/one-step correlation is only .44. Thus, the Final Examination tested most in the category with which self-paced students had the least exposure.

Finally, we note that the Final Examination was constructed before the class reviews. The classroom lecturer could then emphasize principles and methods which were relevant to the Final. (We do not know whether this was actually done). This practice is perfectly proper, and even desirable, but the self-paced group could not enjoy a similarly well-directed review.

It has been suggested that the Final Examination has not tested what was taught, that the self-paced group may have experienced some disadvantages, and that the conventional group may have enjoyed some benefits. Nevertheless, the self-paced and conventional groups had the same performance. The only hard conclusion which can be drawn from these rather

insubstantial considerations is that self-paced instruction is no less effective than conventional instruction.

Perhaps a more meaningful comparison can be made. Before he encounters the core problem, a self-paced student receives instruction which, in content and delivery, is virtually identical to conventional instruction. That is, he reads the textbook assignment, is exposed to videotape instruction or another medium which essentially replaces a lecture demonstration, and is informed through an Information Panel of his terminal objective (a good conventional section should include this feature, as the Academy conventional sections did).

The self-paced student, therefore, has had essentially "conventional" instruction, albeit automated, when he addresses the core problem. The core problem corresponds to a homework problem in the textbook in this view. Self-pacing, as a responsive dynamic system, really begins when the result of the core performance is known. Various media options and self-paced individualized paths through a learning sequence start here. The core prime problem ends the sequence for most students (excepting those few needing tutorial assistance).

Consequently a comparison of conventional and self-paced instruction is provided by comparing performance on very parallel core and core prime problems for the same students. This tack certainly removes any need to assure homogeneity of experimental and control groups. The results for the highly parallel problems are recorded in Table 3 (omissions are scored as incorrect in Table 3). Here we see that 16% more students reach criterion through the program, an increase of 28% over the "conventional" performance.

A criticism of this analysis may be raised that we are only comparing less instruction with more instruction and finding in favor of

the latter. This is not at all true. We know from our first revision (which expanded all materials prior to "core") that simply expanding conventional instruction on an objective seldom causes a significant increase in performance (see Introduction of Course Development Report). Although a more definitive test is desirable, we believe that this analysis shows the individualized, self-paced system makes a substantial difference in performance over conventional instruction.

TABLE 3

PROBLEM NUMBER			PERCENT CORRECT	
New Core	New Prime	Old Core	1970 Core	1970 Prime
1/6	1/9	1/16	60	79
2/1	2/5	1/15	67	91
4/6	4/10	4/8	73	89
4/16	4/20	4/21	44	83
5/13	5/17	5/10	40	49
7/5	7/8	7/9	60	77
7/10	7/14	7/24	35	59
7/27	7/29	7/22	31	48
8/5	8/8	8/11	56	54
8/13	8/17	8/17	36	56
9/1	9/3	9/4	75	73
11/1	11/4	11/1	68	92
11/15	11/17	11/24	92	92
13/11	13/14	13/19	46	64
			---	---
			56	72

Other Evaluation Measures

Performance is the most obvious measure of instructional value, but other important considerations should also be addressed. Some evaluation may be made of the students' time required for study and attitude toward the course.

The source of this evaluation is a questionnaire developed and distributed by the Academy at the conclusion of the Fall semester 1970 (see appendix D). It is unfortunate for purposes of comparison that most of the questions were not distributed to conventional sections. Despite this and other shortcomings of the questionnaire, the responses of the self-paced group provide a general picture of student study time, attitude and effort.

Student attitude regarding the time-effectiveness of the program is reflected in several of the questions.

As a result of student-pacing, the amount of time I was able to spend on other subjects was:

A. much more..... 4

B. more..... 35

C. about the same..... 20

D. less..... 20

E. much less..... 3

Almost half of the students thought they were spending less time because of self-pacing. It is probably true that self-paced students spent less time in study than the conventional sections, but the actual time data was too sparsely recorded (by the students themselves) to verify or deny this. One question shows a rathe modest homework effort on the part

of self-paced students:

Did you study physics outside the classroom?

A. over 6 hrs/week..... 11

B. 3-6 hrs per week..... 32

C. 1-3 hrs per week..... 33

D. seldom..... 6

E. never..... 0

A less personalized question reveals that the course work is of manageable proportions:

The amount of material covered in the course should be:

A. greatly increased..... 0

B. increased..... 2

C. maintained..... 63

D. decreased..... 17

E. greatly decreased..... 0

A very important fact is evident. Quite unlike the 1969 experimental run, students taking the revised program had no overload placed on their study time. The principal goal of the 1970 revision was successful.

Student attitude toward the program is less well defined. Overall, the course was considered more difficult than other science courses and half of the students felt they learned less from this "method of material presentation" as compared with conventional instruction. More detailed questions regarding self-pacing and various components, however, indicate a general preference in favor of the program's approach.

It is part of academic folklore that, among all the basic subjects in the engineering curriculum, the introductory course in physics with calculus is by far the most difficult. In view of this notoriety, the self-paced students' attitude about the difficulty as reflected in the questionnaire is not extreme.

Compared to other science classes that I have taken at the Academy I think this class is

A. much easier	*0*
B. easier	*9*
C. about the same	*30*
D. harder	*32*
E. much harder	*10*
No response	*(1)*

Only 10 students out of 81 answering the question thought the course was much more difficult than other science courses.

Another question reflects the students' attitude about what they *think* they learned:

Because of the method of material presentation compared to the "conventional" method of lecturing I believe I learned:

A. much more	*0*
B. more	*20*
C. about the same	*20*
D. less	*29*
E. much less	*12*
No response	*(1)*

Of course, this response may show a "protest vote" by the students who felt that the course was harder than other science classes. There is almost complete overlap between the students responding D and E here and those responding D and E to the preceding question.

Some of the questions and responses regarding components of the program are listed below. A generally positive attitude toward self-pacing, laboratories, the Problem and Solution Book, and various media (excepting TV tapes) is reflected here.

I _____ *have all physics labs in the self-paced format.*

A. strongly would like..... 45

B. would rather..... 26

C. no preference..... 5

D. would rather not..... 6

E. would not want to..... 0

As a way of organizing a course, I think that letting students pace themselves and manage their own progress is:

A. extremely beneficial..... 3

B. very beneficial..... 30

C. adequate..... 24

D. not very beneficial..... 22

E. useless..... 3

Were the questions and information in the Problem and Solution Books helpful in understanding the objectives?

A. extremely helpful..... 4

B. very helpful..... 26

C. adequate..... 32

D. not very helpful..... 18

E. useless..... 2

Did you find the Problem and Solution Book helpful in preparing for Quarterly Diagnostic Tests?

A. very valuable..... 11

B. helpful..... 33

C. so-so..... 23

D. not very helpful..... 10

E. wasted effort..... 5

Did the Problem and Solution Book provide adequate preparation for the Progress Checks?

A. very good preparation..... 3

B. good preparation..... 25

C. adequate preparation..... 39

D. poor preparation..... 13

E. poor preparation..... 2

Was the material presented on the TV tapes adequately explained?

A. very clear..... 2

B. clear..... 15

C. adequately clear..... 43

D. poorly explained..... 11

E. unuseable..... 5

No response..... (6)

Did seeing the physics phenomenon demonstrated on TV aid in your understanding of the concept?

A. extremely helpful..... 2

B. very helpful..... 8

C. adequate..... 40

D. not very helpful..... 22

E. useless..... 4

No response..... (6)

Did you study physics outside the classroom?

A. over 6 hours per week..... 11

B. 3-6 hours per week..... 32

C. 1-3 hours per week..... 33

D. seldom..... 6

E. never..... 0

The use of "Talking Books" and the audio tapes was

A. very helpful..... 5

B. helpful..... 19

C. adequate..... 37

D. not very helpful..... 13

E. useless..... 7

No response..... (1)

Using the "Illustrated Book" is

A. valuable..... 6

B. helpful..... 15

C. OK..... 35

D. not very helpful..... 16

E. wasted effort..... 7

No response..... (3)

Students ranked the media they found most effective for learning physics in the following order (from most to least effective):

Problem and Solution Book

Instructor

Text

Talking Book/Illustrated Book

TV Tape

This list descends from the medium which requires the most active student participation to that which allows the most passive response. On this basis, we are inclined to agree with the students' evaluation. Effectiveness does appear to be closely related to active participation;

in less complex courses this participation is adequately measured by response demand frequency.

The full questionnaire with responses is reproduced in Appendix D.

Media Evaluation

One of the goals set forth at the inception of the program was to establish optimal individualization with respect to media. We sought to determine what media were most efficacious for a student with a known set of background variables. The term media here refers to two classes of material: audiovisual components, which include videotape, talking book, illustrated text, and lecture/demonstration; and fundamental learning instruments, which are the Problem and Solution Book, the textbook, and the on-site instructor.

We were unable to detect significant differences in performance due to the audiovisual materials. However, individual students do have preferences among audiovisual components and this is the basis of the present system of voluntary selection.

Although the use of audiovisual materials evidenced no significant performance differences in the operating program (see 5.0, Statistics: 1969 Experiment), we must not conclude that they are without significant value. We believe these materials are useful for teaching "trouble topics" which are often difficult for students to conceptualize. These often require visual or auditory amplification, redundancy and repetition in various perspectives, and motion. Trouble topics had little representation on examinations even though some instructors insisted that they were essential to the course content. This disparity between what a student *ought* to know (as revealed in

course objectives) and what he is *expected* to know (as revealed in testing) is apparently widespread in the community of science educators. For many professors, it may be that conscience dictates the inclusion of some difficult topics in the course--later, conscience dictates that these topics be excluded from examinations.

Audiovisual materials are also used to provide overviews, enrichment, and to demonstrate the relevance of subject matter in real-world settings and real-life applications. It seems that these are not significant to the task of achieving the specific behavioral objectives. However, such presentations are likely to stimulate audience *interest* in the subject matter--a very desirable general objective for any course. It is improbable that audiovisuals increased interest or motivation in Academy midshipmen; they have no time for such luxuries. Other less motivated and less goal-directed student groups, however, may profit more from audiovisuals.

Three distinct weaknesses of audiovisual materials for a majority of college physics topics are now evident: they are *inefficient* and time-consuming sources of information (as compared with textbooks, for example); they allow for student interaction only with some difficulty and awkwardness (especially notable for high level objectives); and they are not easy to "skim," so that locating a particular fact or objective may require extensive searching. These weaknesses suggest that audiovisuals should not be recommended casually for run-of-the-mill objectives--even when cost is not an important consideration.

The Problem and Solution Book, the textbook, and the on-site instructor are indispensable components of the program as it is presently constituted. Student opinion rated the Problem and Solution Book as the

most effective learning medium. The substantial performance gains deriving from the Problem and Solution Book and the favorable student reaction to it strongly support this opinion. Indeed, our investigators now regard the invention of the Problem and Solution Book as the most important derivative of our development program.

Students rated "instructor" as the second most effective medium. The questionnaire does not specify whether this refers to the on-site instructor who is essentially a highly interactive tutor, or to an idealized conventional lecturer. It may be that rating the instructor as an effective medium was made largely on hypothetical grounds, since several oral interviews indicated that few students sought help from the instructor.

A most important finding of our 1970 data analysis (see Appendix E) concerns the pivotal role of the textbook. Of the seventeen students who thought the textbook was one of the two least effective media, fifteen fell below the average on the adjusted final examination (see Appendix B for core related subtest): 8.6 as compared with the 14.1 average. Moreover, a similar finding holds for the core and core prime problems listed in Table 2: 52% for this group as compared with the average of 72%. Two-thirds of the fifteen students who considered the textbook ineffective and who fell below average on the core related subtest were below average in English Comp. scores.

The implication is that those students who find the text ineffective, or who have difficulty comprehending it, will perform poorly. The remedy seems equally clear. Required reading from the textbook should be abolished, and this material should be incorporated into the Problem and Solution Book format.

Cost Effectiveness

The cost effectiveness of an educational system is often taken as the number of criteria attained per unit cost. While this measure has a certain appeal, it is an abstraction insofar as existing educational institutions do not graduate students on the basis of the total attained criteria. Thus, a more realistic measure of cost effectiveness is simply the number of students processed through the course (regardless of achievement) per unit cost.

Instructor salaries constitute a major cost in education. Academy policy limits class sections to no more than twenty students per instructor. Although many more students can be served by one instructor using the self-paced program, the Academy constraint prevents the realization of a gain in cost effectiveness over the conventional system. Estimates of the number and cost (in man-hour currency) of instructors and clerks needed to serve different numbers of students are given in the cost section of TR 5.10, Course Development. Generally, cost effectiveness increases with increased numbers of students. In some cases a gain of 100% or more in cost effectiveness seems likely with the use of the existing program.

Another major cost of education is overhead. Through the use of the self-paced program, there exists the possibility of reducing the required classroom space--a factor which would further enhance the program cost effectiveness (see the Course Development report for further discussion of this point).

For educators who are considering developing their own self-paced program, the attractive possibility of a highly cost effective program must be amortized against development and installation costs. These costs vary greatly, depending upon the materials and sophistication desired. Since a similar variability exists in determining the cost

effectiveness of an operating program, we suggest that estimates assessing specific situations be made with the assistance of the Course Development report.

APPENDIX A

1970 CORE AND CORE PRIME DATA

(Columns refer to Segment/Core Problem and Segment/Core Prime Problem, respectively.)

C = CORRECT, X = INCORRECT, – = NO ANSWER

APPENDIX A

	NAME	1/6	1/9	2/1	2/5	4/6	4/10	4/16	4/20	5/13	5/17	6/2	6/7	7/5	7/8	7/10	7/14	7/27	7/29	8/5	8/8	8/13	8/17	9/1	9/3	11/1	11/4	11/15	11/17	13/11	13/14
C.	L	C	–	C	C	C	–	C	–	X	C	X	X	X	X	X	X	C	–	C	–	C	–	C	–	C	–	C	–	X	X
Cs	M	C	–	X	C	C	–	C	–	C	–	C	–	X	X	X	X	X	C	C	–	X	X	X	C	X	C	C	–	C	–
DL	S, C	C	X	X	C	C	–	C	–	X	X	X	X	C	–	C	X	X	–	C	C	C	C	C	–	C	–	C	C	C	C
EI	, R	C	–	X	C	C	–	X	X	X	C	X	C	C	–	X	–	X	–	C	C	X	C	C	–	C	C	C	–	X	X
E	, B	C	C	C	C	X	C	C	C	C	C	X	X	C	C	X	C	X	C	X	X	X	X	C	–	C	C	C	C	C	–
H.		C	–	C	C	C	C	X	C	X	X	X	C	X	X	X	X	X	X	C	–	C	X	C	X	X	C	X	X	X	X
H.	, R																									C	–	C	–	X	X
Hi	N, J																									X	X	C	C	X	X
KA	EIS, F	C	–	C	–	C	C	X	C	C	C	X	C	C	C	C	–	C	–	C	–	C	–	C	–	C	–	C	–	X	C
M.	IG, A.	X	C	X	C	C	X	C	C	C	–	X	–	X	X	C	C	X	–	X	X	C	C	C	–	C	–	C	–	X	X
PA				C	–	C	–	X	C	C	–	X	–	C	–	C	–	C	–	C	–	C	–	C	–	C	–	C	–	C	C
SI	SON, W	X	C	X	C	X	C	X	C	X	–	X	X	C	–	C	–	X	–	–	–	C	–	C	–						
SC	, T	X	C	C	C	C	C	C	C	–	C	X	X	C	X	–	–	X	X	C	X	X	C	C	–	X	C	C	C	C	X
TR	, C	C	–	X	C	C	C	X	X	C	–	X	–	X	C	C	X	C	–	C	–	X	C	C	–	C	–	C	–	C	C
TR	, J	C	X	C	C	X	X	X	X	C	X	X	X	C	–	X	C	C	–	X	X	X	C	C	–	X	C	C	–	C	X
AB	ZEL, D	X	C	C	C	C	C	X	C	X	X	X	C	X	C	C	C	–	–	C	–	C	–	C	–	C	–	C	–	C	–
DO	L, J	C	C	C	–	C	–	X	C	X	X	X	C	X	X	C	C	X	X	X	X	C	C	C	–	X	C	C	C	C	C
EI		C	–	X	C	X	C	X	–	X	–	X	–	X	–	X	–	X	C	X	X	C	–	C	–	X	C	C	–	X	C
G.	L, B	C	–	C	–	C	–	C	–	C	–																				
GR	95, G	X	X	X	C	C	–	C	–	–	C	X	–	C	–	–	–	–	–	C	–	X	X	C	–	C	–	C	–	C	C
MEL	SON	C	X	–	C	X	C	X	C	X	X	X	X	C	C	X	X	–	–	X	C	X	X	C	–	C	C	C	C	X	C
HE		C	X	X	C	C	–	X	C	X	X	X	X	X	X	X	X	X	–	–	–	–	–	–	–	C	–	C	–	X	–
JOI	D	C	–	C	C	C	–	X	C	C	–	X	–	C	–	X	C	X	–	X	–	–	–	C	–	C	–	C	–	–	–
KOA	, M	C	C	X	C	C	C	X	C	C	C	X	X	C	C	X	C	–	X	C	–	X	C	C	–	X	C	C	C	X	X
KR	H, R	C	–	C	C	C	C	C	–	C	–	X	–	X	C	X	–	X	–	C	–	X	–	C	–	C	C	C	–	C	C
MA.	J	C	–	X	–	X	C	X	C	–	–	C	–	C	–	C	–	X	–	X	C	C	–	C	–	C	–	C	–	X	C
MAR	J	C	–	C	–	C	–	C	–	C	–																				
MAI	P	X	X	C	C	X	C	X	–	X	C	C	C	X	X	X	X	X	C	X	X	X	X	C	–	C	–	C	–	C	–

C = CORRECT X = INCORRECT — = NO ANSWER

APPENDIX A

	NAME	1/6	1/9	2/1	2/5	4/6	4/10	4/16	4/20	5/13	5/17	6/2	6/7	7/5	7/8	7/10	7/14	7/27	7/29	8/5	8/8	8/13	8/17	9/1	9/3	11/1	11/4	11/15	11/17	13/11	13/14
1	R	C	-	C	-	C	-	X	-	X	-																				
2	S	X	C	C	-	C	-	X	C	C	-	X	-	X	-	X	C	X	-	C	-	C	-	C	-	X	X	C	-	X	C
3	M	X	C	C	-	C	-	C	-	-	-	X	-	C	-	C	-	X	-	C	-	X	-	C	-	C	-	C	-	C	-
4	D	C	-	C	-	C	-	-	-	-	-	X	-	C	-	C	-	C	-	X	-	X	-	C	-	C	-	C	-	X	-
5	M	C	C	X	C	X	-	C	-	X	C	X	X	X	C	X	C	X	C	C	-	X	C	C	-	C	-	C	-	C	X
6	R, D	C	C	C	-	C	-	C	-	-	-	X	X	C	-	X	C	-	-	-	-	-	-	-	-	C	-	C	-	X	C
7																															
8	S, J	C	-	C	-	C	-	C	-	X	C	X	X	C	-	X	C	X	X	C	-	X	-	C	-	C	-	C	-	C	C
9	W, J	C	C	C	C	X	C	X	C	C	C	X	X	C	-	-	-	X	C	C	X	C	C	C	-	C	-	C	-	C	C
10	D	C	C	X	C	C	-	X	-	C	-	X	-	X	-	X	-	X	-	C	-	X	-	C	-	X	C	C	-	X	C
11	J	C	-	X	C	C	-	C	-	C	-	X	-	C	-	X	C	C	-	C	C	C	-	C	-	C	-	C	-	C	-
12	RT, J	X	C	C	C	X	C	X	C	X	C	X	C	X	C	C	C	C	-	C	-	C	-	C	-	C	X	C	X	C	X
13	N, J	X	-	C	-	X	-	X	C	X	X															C	-	C	-	X	-
14	S, J	X	C	C	-	C	-	X	-	C	-	X	-	C	-	X	-	X	-	C	-	X	-	C	-	X	-	C	-	X	-
15	M	C	-	X	C	C	C	C	-	X	-															C	-	C	-	C	-
16	AND, D	C	C	C	C	C	-	X	X	C	X	X	C	C	C	X	X	C	C	C	C	C	C	C	C	C	C	C	C	X	C
17	N, J	C	X	C	C	X	-	X	-	-	-															X	C	C	-	C	X
18	SON, R	X	C	C	C	C	C	X	C	C	C	X	X	C	C	X	-	-	-	-	-	-	-	-	-	C	C	X	X	C	X
19	WALL, D	C	C	C	C	C	-	C	-	C	-															C	-	C	-	C	C
20	T	C	-	C	-	X	C	X	-	X	X	X	-	C	C	C	C	X	-	C	X	X	C	C	C	X	C	C	C	X	C
21	Y, J	C	-	C	-	C	-	C	-	X	C	C	-	C	-	C	-	C	-	C	-	C	C	C	-	C	C	C	-	C	-
22	ER, R	X	C	C	C	C	-	C	X	C	-	C	-	C	-	X	-	C	-	X	-	X	-	C	-	C	-	X	C	X	C
23	DE, W	X	C	C	C	C	-	C	-	C	-	X	C	C	-	-	-	X	-	X	-	C	-	X	X	C	-	C	-	C	-
24	, D	C	-	C	-	C	-	C	-	-	-	X	-	X	C	X	C	-	-	-	-	-	-	-	-						
25	T, P	C	C	C	C	C	C	X	C	X	X															X	X	C	C	X	X
26	GA C	C	C	X	C	C	C	C	C	C	X															C	C	C	-	X	C
27	S, E	X	C	X	C	X	C	C	-	X	X	X	-	C	-	-	-	C	-	C	-	C	-	X	C	C	-	C	-	X	X
28	ERS, C	C	-	X	C	C	-	C	-	C	-															C	-	C	-	X	-

27

C = CORRECT X = INCORRECT — = NO ANSWER

APPENDIX A

	NAME	1/6	1/9	2/1	2/5	4/6	4/10	4/16	4/20	5/13	5/17	6/2	6/7	7/5	7/8	7/10	7/14	7/27	7/29	8/5	8/8	8/13	8/17	9/1	9/3	11/1	11/4	11/15	11/17	13/11	13/14
A	TROUT, M	X	C	C	–	C	–	C	–	X	C	X	C	C	–	C	–	X	C	C	–	X	–	C	–	C	–	C	–	C	–
C	R, E	C	–	X	C	C	–	X	C	X	X	C	–	X	C	X	X	C	–	C	–	C	–	C	–	C	–	C	–	C	–
L	A S	X	C	C	–	X	C	X	C	X	X	X	C	X	C	X	C	X	C	X	X	X	C	C	–	X	C	C	X	X	X
L	R	C	C	C	C	C	–	C	–	C	X	X	C	C	–	C	–	C	–	C	–	C	–	–	–	X	C	C	–	X	C
L	R	X	C	C	X	X	C	X	–	X	C	X	X	X	C	X	X	X	X	X	X	X	X	C	–	C	C	C	C	C	C
	RECK	X	C	C	–	C	–	C	–	C	X	X	C	C	–	X	C														
	TTER G.	X	C	C	–	C	–	X	C	X	C															C	–	C	–	C	–
	, S	X	X	C	X	C	C	C	C	X	X															C	C	X	C	X	–
	, J	X	C	C	–	C	C	C	C	X	C															C	–	C	–	C	–
I	ON, H.	C	C	C	C	C	C	C	C	X	X	X	X	C	C	C	C	X	X	C	C	X	X	C	–	C	C	C	–	X	C
	, R	C	C	C	–	C	C	C	C	C	C																				
H	ER, P	C	–	C	C	C	–	X	C	C	C	X	X	C	–	C	–	X	–	C	–	C	–	C	–	C	–	C	–	C	–
	~~E~~ S																														
	RD, R	X	C	C	–	C	–	C	–	C	–															C	–	C	–	X	C
	V, J	X	C	X	C	C	C	X	C	C	C	X	C	X	C	X	C	C	–	C	–	X	C	C	–	C	C	C	X	C	C
	F, F	C	–	C	–	C	–	C	–	X	C															C	–	C	–	X	X
	, T	X	C	C	–	C	–	X	C	X	X	X	C	X	C	X	C	C	–	–	–	–	–	–	–	C	–	C	–	C	–
	D																									X	C	C	C	C	–
	S	C	–	C	–	C	–	X	C	C	–															C	C	C	–	C	–
	L, R	C	–	X	C	X	–	C	–	C	–																				
	SON C	C	C	X	C	C	C	C	–	C	–	X	X	C	–	X	C	X	X	C	–	X	C	–	–	C	–	C	–	C	C
	L	X	C	X	C	X	C	X	C	X	C															C	C	C	–	C	–
	GAY	C	C	C	C	C	C	X	C	–	–	X	–	C	–	C	–	C	–	C	–	C	–	C	–	X	C	C	C	C	–
K	UK, J	X	X	C	C	X	C	X	C	X	X	X	X	X	C	X	X	C	–	X	X	X	C	C	C	X	C	C	C	X	C
	BART, D	C	X	X	C	C	C	X	C	C	C	X	X	X	C	X	C	X	C	C	X	X	X	C	C	X	X	X	C	X	X
	HI, W	C	–	C	–	C	–	X	C	C	–	X	X	X	C	C	–	–	–	–	–	–	–	–	–	X	C	X	C	X	C
	~~F~~																														
	IZEK, J	X	C	C	–	C	C	X	C	C	C	X	+	C	–	X	X	–	–	C	–	C	–	C	–	C	–	C	–	X	–

A31

26

C = CORRECT X = INCORRECT — = NO ANSWER

APPENDIX A

NAME	1/6	1/9	2/1	2/5	4/6	4/10	4/16	4/20	5/13	5/17	6/2	6/7	7/5	7/8	7/10	7/14	7/27	7/29	8/5	8/8	8/13	8/17	9/1	9/3	11/1	11/4	11/15	11/17	13/11	13/14
Mu J	C	C	C	-	C	-	X	C	-	-															X	X	C	C	X	C
Pol , C	X	X	X	C	C	-	X	C	X	C	X	C	-	-	-	-	-	-	-	-	-	-	-	-	X	C	C	-	C	C
SP , J	X	X	C	C	C	-	X	-	C	-	X	-	C	-	X	-	-	-	-	-	-	-	-	-	C	C	C	C	X	-
CAL , M	X	C	C	-	C	C	C	X	X	X	X	X	X	C	C	C	-	-	C	-	-	-	C	-	C	C	C	-	X	-
CHI , J	X	C	C	C	C	C	C	C	C	X	X	C	C	X	C	X	X	X	C	-	X	C	C	X	C	C	C	X	X	C
FAL G, F	C	-	C	C	C	-	C	-	X	X	X	X	X	C	X	C	X	X	X	-	-	-	C	-	C	-	C	-	C	-
FLE J	X	C	C	-	C	-	C	-	X	C	X	C	C	-	X	X	C	-	C	-	C	-	C	-	C	C	C	-	C	-
HAN	X	X	X	X	C	C	X	C	C	C	X	X	X	-	X	-	C	-	X	-	C	-	C	X	X	C	C	X	X	-
HAN A	C	X	C	C	C	-	C	-	X	C	X	C	C	C	C	C	X	C	C	C	X	X	X	X	C	C	C	C	C	C
HER	X	X	C	-	X	-	X	-	-	-	X	C	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
LAS W	X	X	X	C	C	-	X	C	X	X	X	X	C	-	X	X	-	-	-	-	-	-	-	-	C	-	C	-	C	-
LER D.	C	C	C	C	C	C	X	C	-	-	X	C	X	C	X	C	X	C	X	X	C	C	C	C	C	C	X	C	X	C
O'M	X	X	C	-	X	-	X	C	C	X	X	C	C	-	X	C	X	C	C	-	X	C	C	-	C	-	C	-	X	C
PEN	X	X	C	-	C	-	X	C	C	-	X	-	-	-	-	-	C	-	C	-	C	-	C	-	X	C	C	-	C	-
POW C.	C	-	C	-	C	C	X	C	X	X	C	-	C	-	C	-	X	-	C	-	C	-	C	-	C	C	C	-	C	X
RIT , S.	C	C	C	C	C	C	X	C	X	C	X	C	C	C	X	C	X	C	C	C	X	C	C	C	C	C	C	C	X	X
VUG EN, D.	C	-	C	C	X	C	X	-	C	-	X	-	C	-	C	-	C	-	C	-	C	-	X	-	X	C	C	-	C	-
WIL E.	C	C	C	C	C	-	C	-	X	C	X	C	C	-	C	-	C	-	C	X	C	-	C	-	C	-	C	-	X	C
AXL G	C	-	X	C	C	-	X	C	-	-	X	X	C	-	C	-	X	-	C	-	X	-	C	-	C	C	C	C	C	-
BAC J	C	C	C	-	-	-	-	-	-	-															C	C	C	C	X	C
CAG	C	X	X	C	X	C	C	C	C	C	X	X	C	-	X	-	X	C	X	X	X	C	C	-	X	C	C	C	C	-
CLI D, J	X	C	C	-	C	-	X	C	-	C	X	X	C	-	X	-	C	-	X	-	C	-	C	C	C	C	C	C	X	C
DUL R	C	-	C	-	C	C	X	C	-	-	X	X	C	X	X	-	-	-	-	-	-	-	-	-	C	C	C	C	C	X
GLI J	X	X	C	C	C	C	X	C	-	-	C	-	C	-	C	-	X	X	X	X	-	-	C	-	X	C	C	-	X	-
GOL S	X	C	C	-	X	C	X	C	C	-	C	-	C	-	X	X	X	C	C	-	C	-	C	-	C	-	C	-	X	C
HAL CK	X	X	X	C	X	C	X	C	C	-	C	-	C	-	C	C	X	C	C		X	C	X	X	C	-	C	-	X	X
KEN R	C	-	C	C	C	-	C	-	X	C	C	-	X	C	C	C	X	-	X	C	C	-	C	-	C	-	C	-	C	C

27

A32

C = CORRECT X = INCORRECT — = NO ANSWER

APPENDIX A

NAME	1/6	1/9	2/1	2/5	4/6	4/10	4/16	4/20	5/13	5/17	6/2	6/7	7/5	7/8	7/10	7/14	7/27	7/29	8/5	8/8	8/13	8/17	9/1	9/3	11/1	11/4	11/15	11/17	13/11	13/14
IN, M	C	C	C	-	X	X	C	-	-	-	X	X	C	-	X	C	X	-	C	-	X	-	C	-	C	-	C	C	X	X
IWSKI, R	X	X	C	C	C	-	C	-	-	-	X	C	C	-	X	C	C	-	C	X	X	C	C	-	C	-	C	-	C	C
Y, S	X	C	X	X	-	-	-	-	-	-	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	C	X	X	X	X
, W	X	C	C	-	X	C	C	C	-	C	X	X	X	C	X	C	X	X	C	-	X	C	C	-	X	C	C	-	X	X
T	C	-	X	C	C	-	X	C	C	X	C	X	X	C	X	C	C	X	X	X	X	-	X	X	X	C	C	-	X	C
F	C	X	X	C	C	X	X	C	X	X	C	X	X	C	X	X	C	C	C	X	C	C	C	X	X	C	C	C	X	X
AT	C	C	C	C	C	C	X	C	-	C	C	C	X	C	C	C	-	-	-	X	X	C	C	-	X	C	C	C	X	X
VILLE, J	C	X	X	C	X	C	C	-	X	-	C	X	C	C	C	C	C	-	X	X	X	-	X	-	X	C	C	-	C	-
Y, J	C	C	C	C	C	C	C	C	-	C	X	C	C	C	C	C	C	C	C	C	X	C	C	C	C	C	C	C	C	C
ST, R	C	-	X	-	X	-	C	-	X	-	X	X	X	-	X	C	C	-	X	C	X	-	C	-	C	-	C	-	X	-
GTON, P	X	C	C	-	C	-	C	-	C	-	X	X	C	C	X	X	X	C	C	C	X	C	C	-	C	C	C	C	X	C
ER, A	C	C	-	-	X	-	C	-	-	-	X	-	X	X	X	X	-	-	-	-	-	-	-	-	X	X	C	-	X	C
ES, J	X	C	X	X	C	-	X	C	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	C	-	C	-	C	-
E, D	C	-	C	-	C	C	C	-	-	-	X	-	C	-	C	-	-	-	-	-	-	-	C	-	C	C	C	-	C	-
GTON	C	-	X	-	C	-	C	-	C	-	X	-	C	-	C	-	C	-	C	-	X	C	C	-	C	C	X	-	C	-
, W	X	C	C	-	X	C	X	-	-	-	X	X	C	X	X	C	X	-	X	-	X	-	C	-	C	C	C	-	X	X
EY, S	X	X	X	X	C	-	C	-	X	C	X	X	C	-	X	C	-	-	-	-	-	-	-	-	-	-	-	-	X	C
, D	X	-	C	-	C	-	C	-	-	-	X	X	X	-	C	-	X	-	C	-	X	-	X	-	X	C	C	-	X	-
, D	C	-	X	C	X	C	X	C	X	X	X	-	X	X	X	-	C	-	X	-	X	-	C	-	C	-	C	-	X	C
W, D	C	-	C	-	C	-	X	C	C	C	X	C	C	-	X	C	X	C	X	C	C	-	C	-	C	-	C	-	X	C

A533

20

APPENDIX B

PROBLEMS OMITTED FROM FINAL EXAMINATION

APPENDIX B

PROBLEMS OMITTED FROM FINAL EXAM

The Fall 1970 Final Examination contained fifty-five problems. Of these, twenty-six were associated with objectives and learning materials developed by U.S. Naval Academy Faculty. These materials were being used for the first time and so the items were not validated. Of the remaining twenty-nine, two were found to be ambiguous and two did not address core problem objectives. The statements of these problems are listed below.

Problem 1 is ambiguous because distractor B is a correct response as is the intended answer D. Problem 7 addresses an objective which was removed from the program in the last revision; it was decided to confine topics in circular motion to *uniform* circular motion. In Problem 26, "none of the above" may be taken as the correct response because, as fuel is consumed by the rocket, the mass of the system is changing. Self-paced sections were well exposed to variable mass aspects of rocket flight as an Academy requirement, but conventional sections seemed unattuned to this supposed "catch." This, and the failure to sample any variable mass objectives on the Final, leads us to suspect that conventional sections in effect bypassed the topic. Finally, Problem 36 requires a knowledge of the expression for the period of a pendulum. This was not one of the NYIT objectives.

Problem 1. The physical quantities of length, mass, and time in the MKS system are:

A. derived quantities.

B. standard quantities.

C. relative quantities.

D. fundamental quantities.

E. none of the above.

Problem 7. A particle of mass m moves in circular motion with a constant tengential acceleration of 32 ft/sec^2. If the radius of the path is 8.0 ft., what is the magnitude of the total acceleration when the tangential velocity is 16 ft/sec?

A. 32 ft/sec^2

B. 64 ft/sec^2

C. 16 ft/sec^2

D. 45.3 ft/sec^2

E. 22.7 ft/sec^2

Problem 26. A rocket that weighs 5000 lb. on earth is in free space and fires a small course correction motor, generating a thrust of 60 lb. What acceleration results?

A. $1.2 \times 10^{-2} ft/sec^2$

B. $38.4 \times 10^{-2} ft/sec^2$

C. $1.92 \times 10^{2} ft/sec^2$

D. $2.4 \times 10^{-2} ft/sec^2$

E. None of these

Problem 36. A Simple pendulum with a period of 1 sec on the surface of the earth is carried to a point near the moom where the gravitational acceleration is 1.1 m/sec^2. The period of the pendulum is:

A. 1.1 sec

B. 3.3 sec

C. 3.0 sec

D. 9.0 sec

E. independent of the forces of gravity

APPENDIX C

U. S. NAVAL ACADEMY -- FINAL EXAMINATION, FALL SEMESTER 1970

P H Y S I C S S P 2 1 1

G R A P H A N A L Y S E S

Graph per Question of Exam:

1. Total Students of SP211

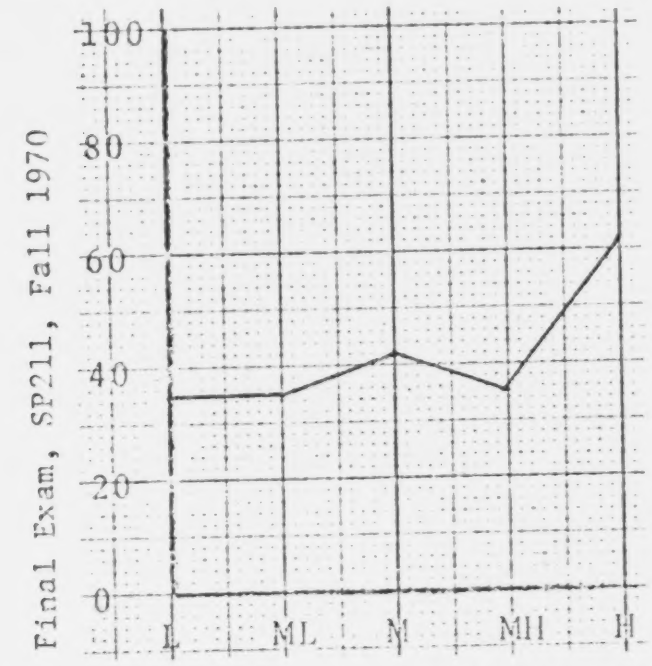
2. Comparative Analysis of:

   (1) Conventional Sections of SP211
   (2) Self-Paced Sections of SP211

in terms of

-- lowest 20% students in raw score performance (L)
-- mid-low 20% students in raw score performance (ML)
-- middle 20% students in raw score performance (M)
-- mid-high 20% students in raw score performance (MH)
-- highest 20% students in raw score performance (H)

TOTAL STUDENTS: Exam Question # 1 (of 55)



	L	ML	M	MH	H
(a)	4	2	1	5	-
(b)	15	19	21	18	14
(c)	9	6	3	4	2
(d)	15	15	18	15	26
(e)	-	1	-	1	-
omit					
Total	43	43	43	43	42

Answer D Percent Correct

L	ML	M	MH	H
35	35	42	35	62

****

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970

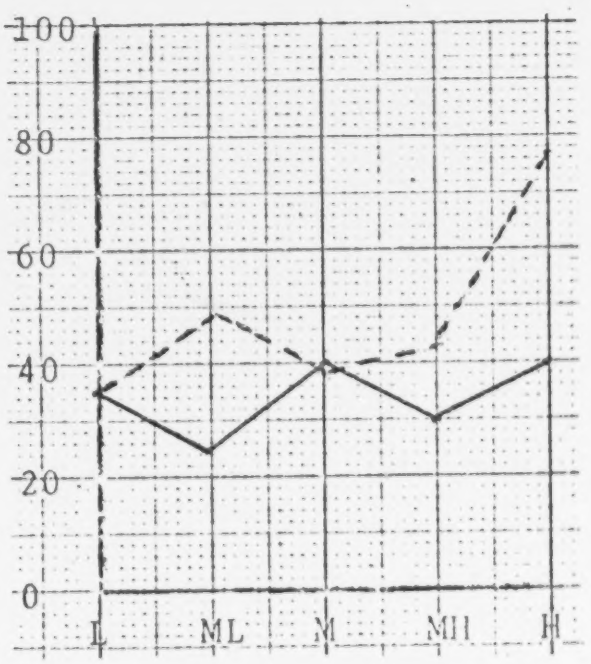
Final Exam # 1 T.O. # 1

COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -



(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"

CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	4	-	2	3	-
(b)	8	9	10	8	5
(c)	3	2	2	1	-
(d)	8	11	9	10	17
(e)	-	1	-	1	-
omit					
Total	23	23	23	23	22

Answer D Percent Correct

L	ML	M	MH	H
35	48	39	43	77

SELF-PACED

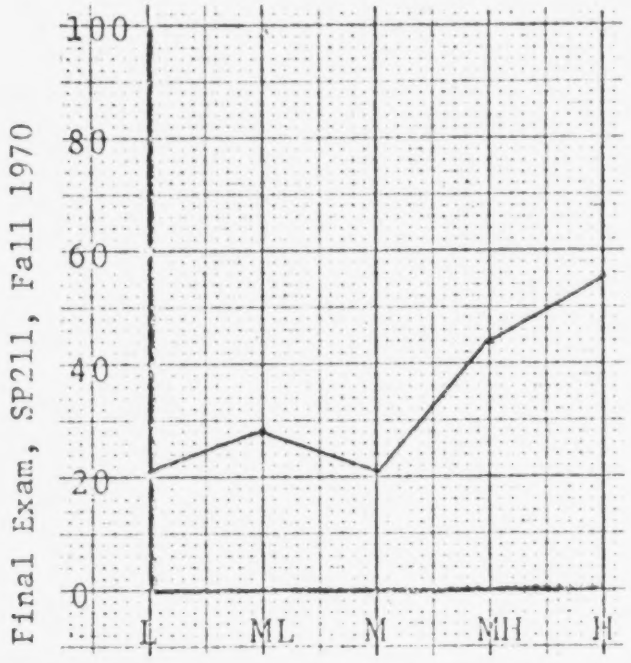
	L	ML	M	MH	H
(a)	-	1	1	1	-
(b)	7	10	10	10	10
(c)	6	4	1	3	2
(d)	7	5	8	6	8
(e)	-	-	-	-	-
omit					
Total	20	20	20	20	20

Answer D Percent Correct

L	ML	M	MH	H
35	25	40	30	40

C1

TOTAL STUDENTS: Exam Question # 2 (of 55)



	L	ML	M	MH	H
(a)	-	-	-	-	-
(b)	9	7	7	6	3
(c)	25	24	27	18	16
(d)	9	12	9	19	23
(e)	-	-	-	-	-
omit					
Total	43	43	43	43	42

Answer D Percent Correct

L	ML	M	MH	H
21	28	21	44	55

****

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970

Final Exam # 2 T.O. # 3

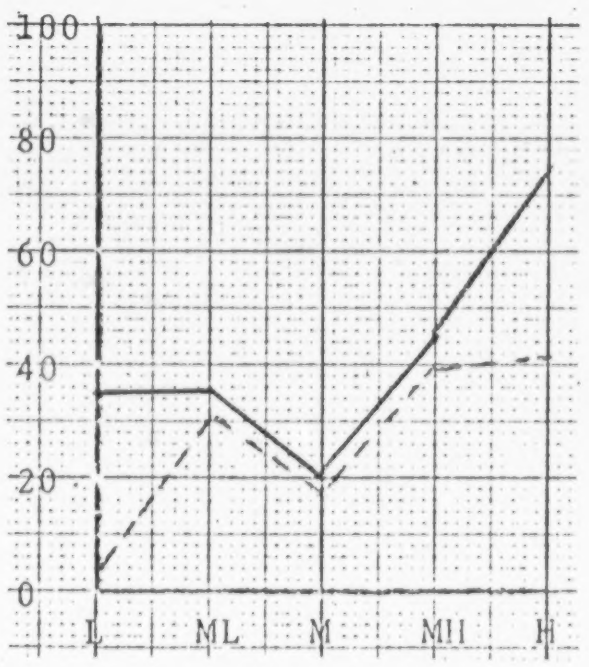
COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ——

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"



CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	-	-	-	-	-
(b)	7	4	4	2	2
(c)	15	12	15	12	11
(d)	1	7	4	9	9
(e)	-	-	-	-	-
omit					
Total	23	23	23	23	22

Answer D Percent Correct

L	ML	M	MH	H
4	30	17	39	41

C2

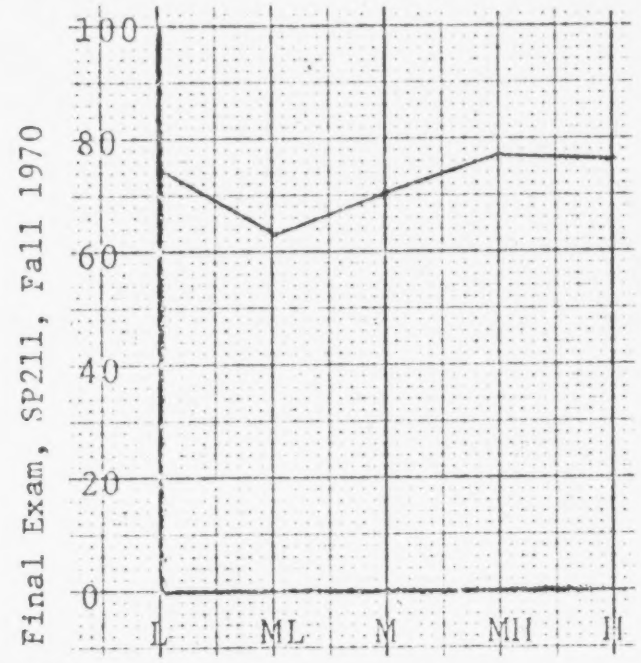
SELF-PACED

	L	ML	M	MH	H
(a)	-	-	-	-	-
(b)	3	3	3	3	1
(c)	10	10	13	8	4
(d)	7	7	4	9	15
(e)	-	-	-	-	-
omit					
Total	20	20	20	20	20

Answer D Percent Correct

L	ML	M	MH	H
35	35	20	45	75

TOTAL STUDENTS: Exam Question # 3 (of 55)



	L	ML	M	MH	H
(a)	4	1	1	2	1
(b)	2	1	4	2	1
(c)	1	1	2	-	-
(d)	32	27	30	33	32
(e)	4	13	6	6	8
omit					
Total	43	43	43	43	42

Answer D Percent Correct

L	ML	M	MH	H
74	63	70	77	76

****

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970

Final Exam # 3 T.O. # 4

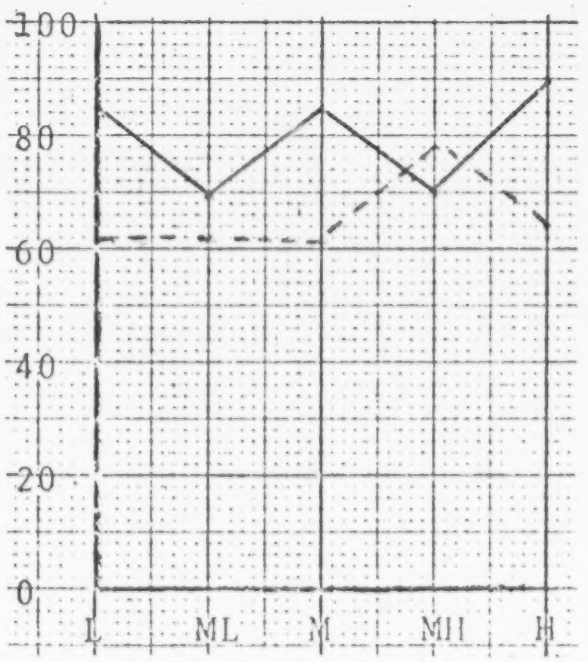
COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"



CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	4	1	1	1	1
(b)	3	2	1	1	1
(c)	-	-	2	-	-
(d)	14	14	14	18	14
(e)	2	6	5	3	6
omit					
Total	23	23	23	23	22

Answer D Percent Correct

L	ML	M	MH	H
61	61	61	78	64

SELF-PACED

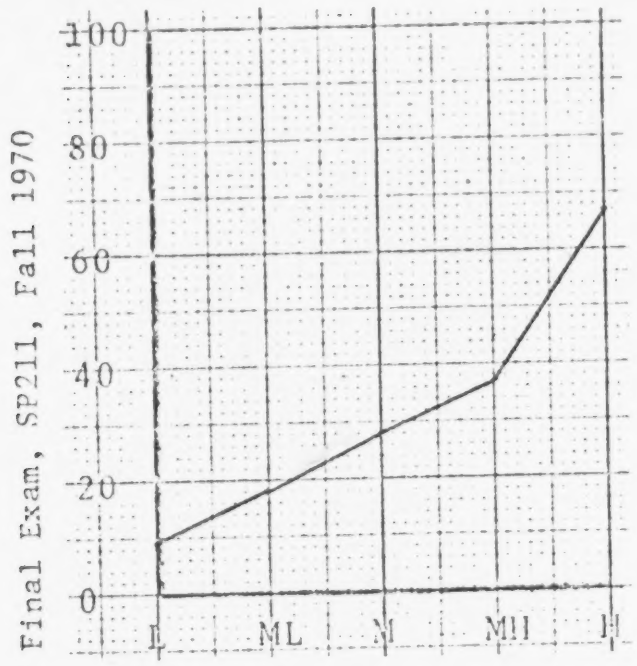
	L	ML	M	MH	H
(a)	-	-	-	1	-
(b)	-	-	-	2	-
(c)	1	1	-	-	-
(d)	17	14	17	14	18
(e)	2	5	3	3	2
omit					
Total	20	20	20	20	20

Answer D Percent Correct

L	ML	M	MH	H
85	70	85	70	90

C3

TOTAL STUDENTS: Exam Question # 4 (of 55)



	L	ML	M	MH	H
(a)	31	29	17	15	9
(b)	4	8	12	16	28
(c)	5	4	9	3	3
(d)	3	1	5	8	2
(e)	-	1	-	1	-
omit					
Total	43	43	43	43	42

Answer B Percent Correct

L	ML	M	MH	H
9	18	28	37	67

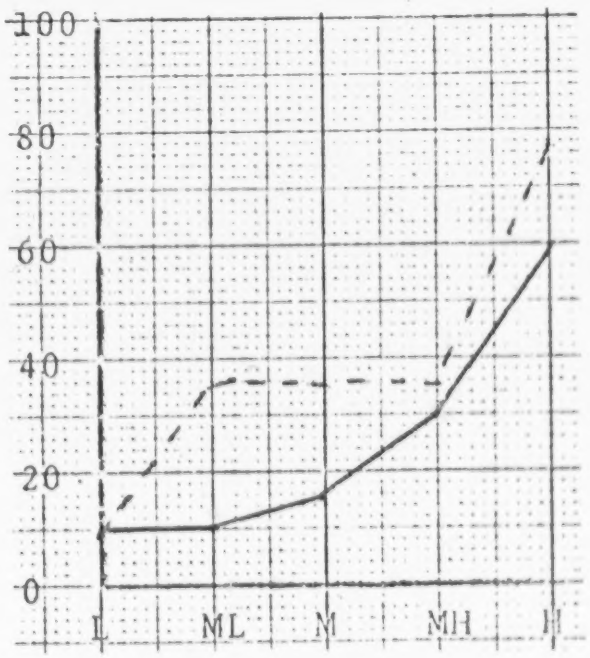
****

Final Exam # 4 T.O. # 7

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970



COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"

CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	15	9	8	8	4
(b)	2	8	8	8	17
(c)	4	5	4	2	1
(d)	2	1	3	5	-
(e)	-	-	-	-	-
omit					
Total	23	23	23	23	22

Answer B Percent Correct

L	ML	M	MH	H
9	35	35	35	77

SELF-PACED

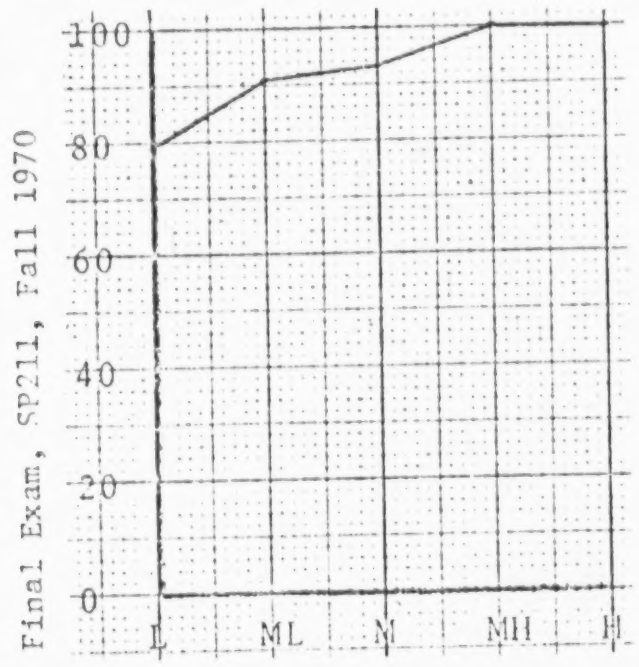
	L	ML	M	MH	H
(a)	16	17	12	8	4
(b)	2	2	3	6	12
(c)	1	-	4	1	2
(d)	1	-	1	4	2
(e)	-	1	-	1	
omit					
Total	20	20	20	20	20

Answer B Percent Correct

L	ML	M	MH	H
10	10	15	30	60

C4

TOTAL STUDENTS: Exam Question # 5 (of 55)



	L	ML	M	MH	H
(a)	2	1	1	-	-
(b)	34	39	40	43	42
(c)	-	-	-	-	-
(d)	2	1	1	-	-
(e)	5	2	1	-	-
omit					
Total	43	43	43	43	42

Answer B Percent Correct

L	ML	M	MH	H
79	91	93	100	100

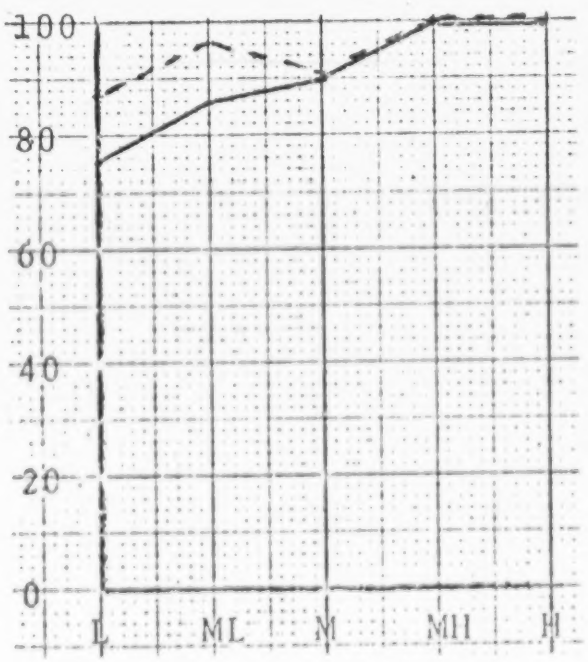
****

Final Exam # 5 T.O. # 6

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970



COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"

CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	-	1	-	-	-
(b)	20	22	21	23	22
(c)	-	-	-	-	-
(d)	-	-	1	-	-
(e)	3	-	1	-	-
omit					
Total	23	23	23	23	22

Answer B Percent Correct

L	ML	M	MH	H
87	96	91	100	100

SELF-PACED

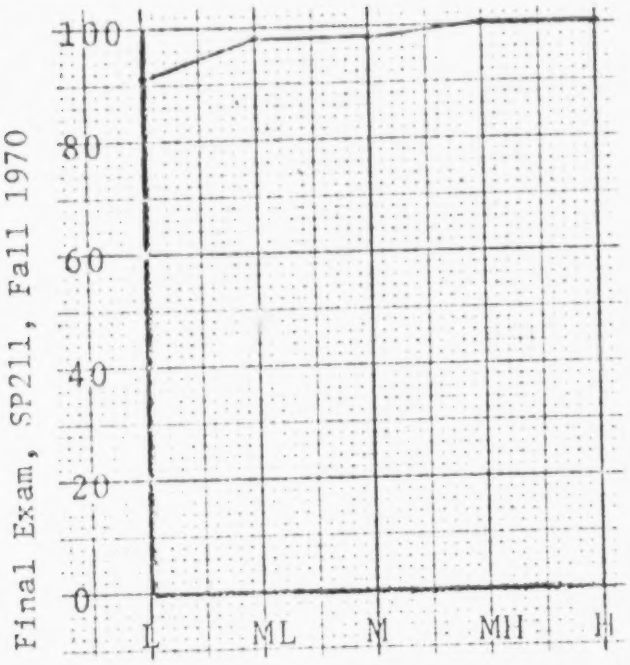
	L	ML	M	MH	H
(a)	2	-	1	-	-
(b)	15	17	18	20	20
(c)	-	-	-	-	-
(d)	1	2	-	-	-
(e)	2	1	1	-	-
omit					
Total	20	20	20	20	20

Answer B Percent Correct

L	ML	M	MH	H
75	85	90	100	100

C5

TOTAL STUDENTS: Exam Question # 6 (of 55)



	L	ML	M	MH	H
(a)	-	1	-	-	-
(b)	39	42	42	43	42
(c)	2	-	-	-	-
(d)	-	-	1	-	-
(e)	2	-	-	-	-
omit					
Total	43	43	43	43	42

Answer B Percent Correct

L	ML	M	MH	H
91	98	98	100	100

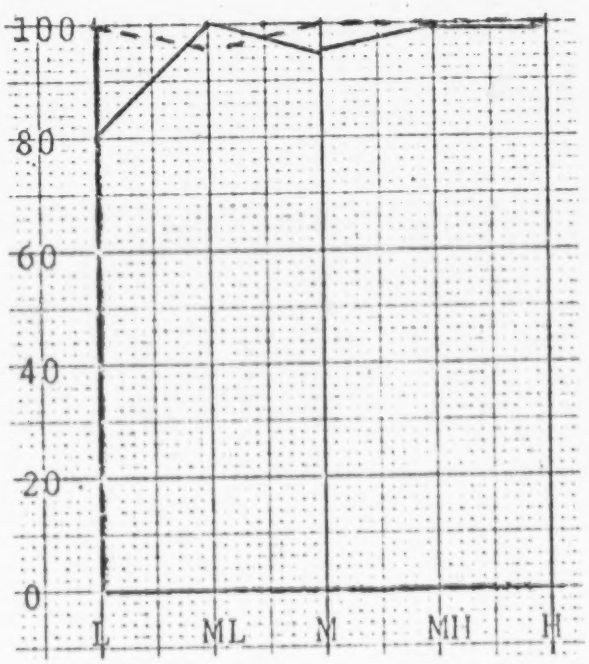
****

Final Exam # 6 T.O. # 12

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970



COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"

CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	-	1	-	-	-
(b)	23	22	23	23	22
(c)	-	-	-	-	-
(d)	-	-	-	-	-
(e)	-	-	-	-	-
omit					
Total	23	23	23	23	22

Answer B Percent Correct

L	ML	M	MH	H
100	96	100	100	100

SELF-PACED

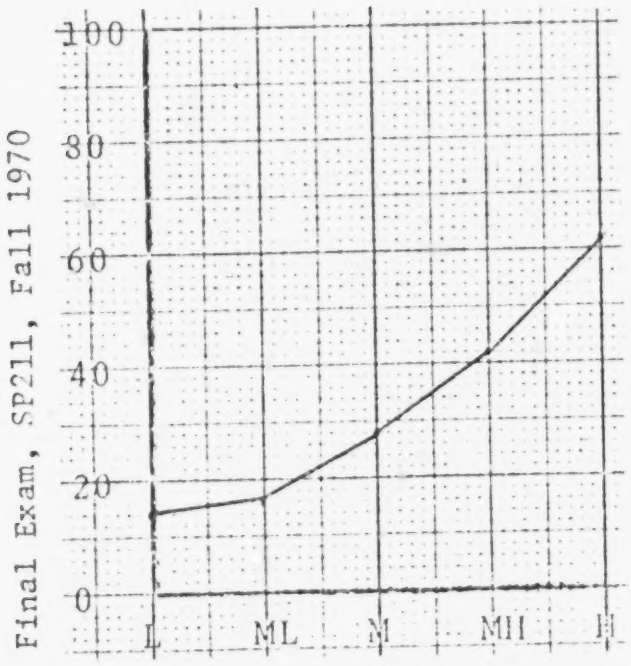
	L	ML	M	MH	H
(a)	-	-	-	-	-
(b)	16	20	19	20	20
(c)	2	-	-	-	-
(d)	-	-	1	-	-
(e)	2	-	-	-	-
omit					
Total	20	20	20	20	20

Answer B Percent Correct

L	ML	M	MH	H
80	100	95	100	100

C6

TOTAL STUDENTS: Exam Question # 7 (of 55)



	L	ML	M	MH	H
(a)	26	23	21	20	10
(b)	8	9	3	4	5
(c)	3	4	5	1	-
(d)	6	7	12	18	26
(e)	-	-	2	-	1
omit					
Total	43	43	43	43	42

Answer D Percent Correct

L	ML	M	MH	H
14	16	28	42	62

****

Final Exam # 7 T.O. # 18

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970

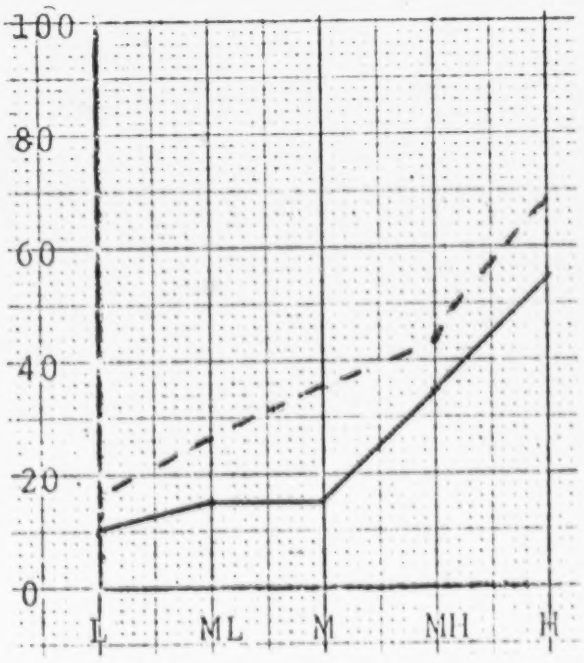
COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"



CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	14	10	11	10	4
(b)	3	4	1	3	2
(c)	2	3	3	-	-
(d)	4	6	8	10	15
(e)	-	-	-	-	1
omit					
Total	23	23	23	23	22

Answer D Percent Correct

L	ML	M	MH	H
17	26	35	43	68

SELF-PACED

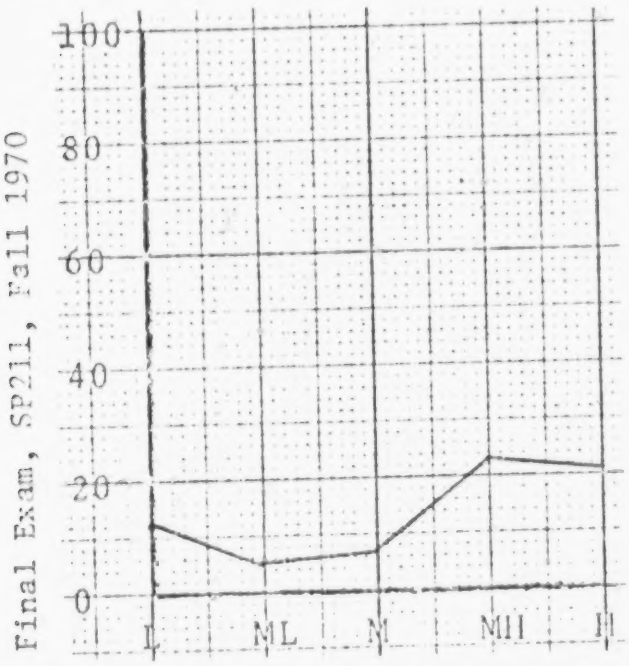
	L	ML	M	MH	H
(a)	12	12	11	9	7
(b)	5	4	3	2	2
(c)	1	1	2	1	-
(d)	2	3	3	7	11
(e)	-	-	1	1	-
omit					
Total	20	20	20	20	20

Answer D Percent Correct

L	ML	M	MH	H
10	15	15	35	55

C7

TOTAL STUDENTS: Exam Question # 8 (of 55)



	L	ML	M	MH	H
(a)	2	2	3	2	-
(b)	4	-	2	-	1
(c)	-	1	2	-	-
(d)	5	2	3	10	9
(e)	32	38	33	31	32
omit					
Total	43	43	43	43	42

Answer D Percent Correct

L	ML	M	MH	H
12	5	7	23	21

****

Final Exam # 8 T.O. # 6

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970

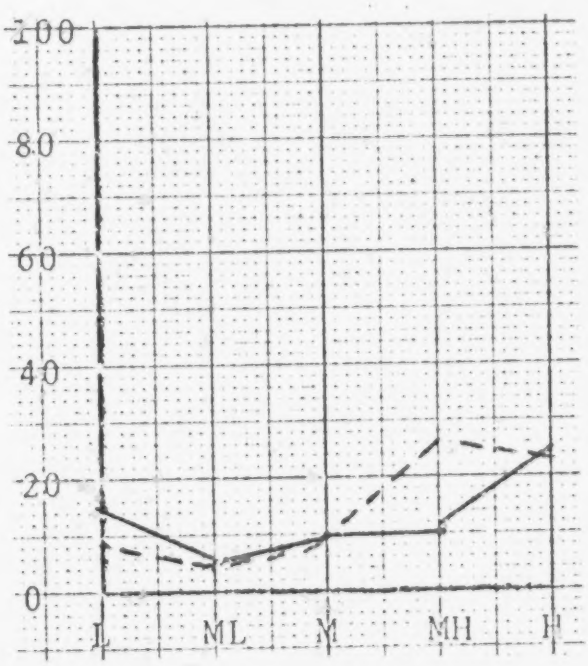
COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"



CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	1	2	-	1	-
(b)	2	-	1	-	1
(c)	-	1	1	-	-
(d)	2	1	2	6	5
(e)	18	19	19	16	16
omit					
Total	23	23	23	23	22

Answer D Percent Correct

L	ML	M	MH	H
9	4	9	26	23

SELF-PACED

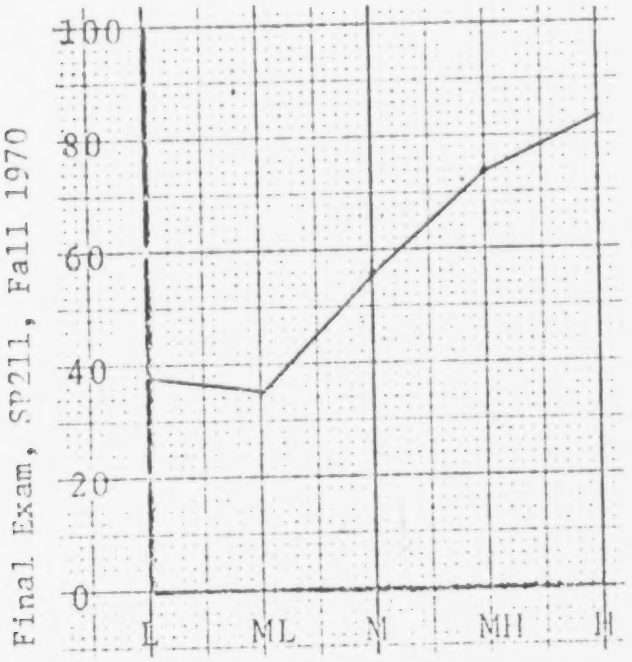
	L	ML	M	MH	H
(a)	1	1	2	1	-
(b)	1	1	1	-	-
(c)	-	-	1	-	-
(d)	3	1	2	2	5
(e)	15	17	14	17	15
omit					
Total	20	20	20	20	20

Answer D Percent Correct

L	ML	M	MH	H
15	5	10	10	25

C8

TOTAL STUDENTS: Exam Question # 9 (of 55)



	L	ML	M	MH	H
(a)	16	15	24	32	35
(b)	17	24	16	10	6
(c)	2	-	-	-	-
(d)	4	2	-	1	-
(e)	4	2	3	-	1
omit					
Total	43	43	43	43	42

Answer A Percent Correct

L	ML	M	MH	H
37	35	56	74	83

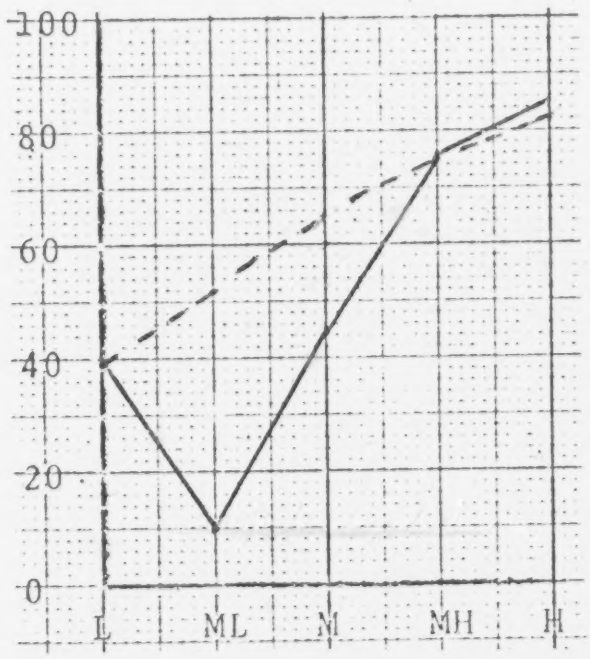
****

Final Exam # 9 T.O. # 10

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970



COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"

CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	9	12	15	17	18
(b)	9	9	6	5	4
(c)	1	-	-	-	-
(d)	2	-	-	1	-
(e)	2	2	2	-	-
omit					
Total	23	23	23	23	22

Answer A Percent Correct

L	ML	M	MH	H
39	52	65	74	82

SELF-PACED

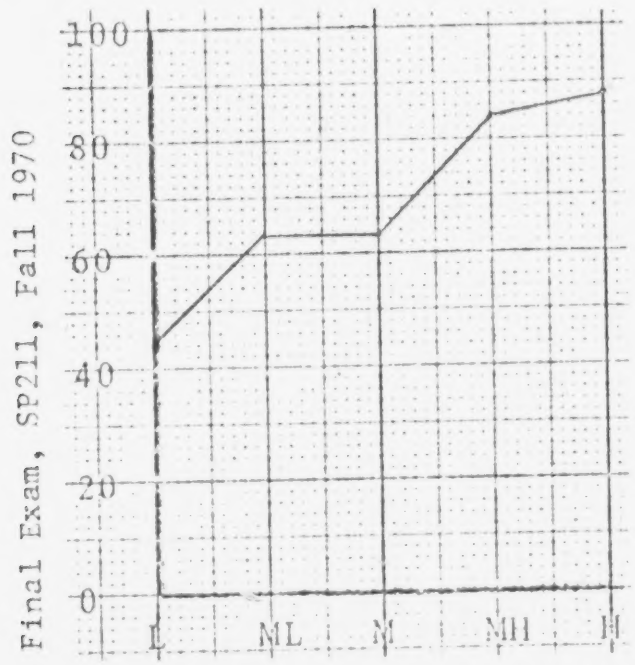
	L	ML	M	MH	H
(a)	8	2	9	15	17
(b)	7	16	10	5	2
(c)	1	-	-	-	-
(d)	2	1	1	-	-
(e)	2	1	-	-	1
omit					
Total	20	20	20	20	20

Answer A Percent Correct

L	ML	M	MH	H
40	10	45	75	85

C9

TOTAL STUDENTS: Exam Question # 10 (of 55)



	L	ML	M	MH	H
(a)	9	3	4	2	1
(b)	17	27	27	36	37
(c)	6	7	4	3	1
(d)	3	2	2	-	-
(e)	6	4	6	2	3
omit					
Total	43	43	43	43	42

Answer B Percent Correct

L	ML	M	MH	H
44	63	63	84	88

****

Final Exam # 10 T.O. # 14

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970

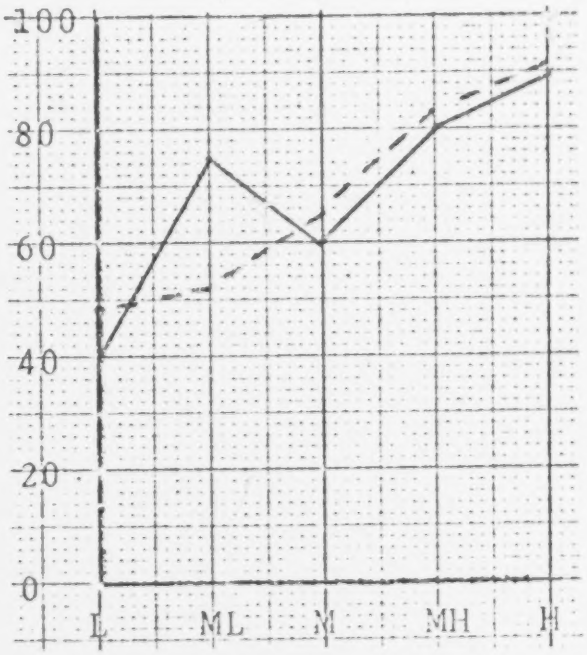
COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"



CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	4	2	1	1	-
(b)	11	12	15	19	20
(c)	4	6	4	1	1
(d)	1	2	1	-	-
(e)	3	1	2	2	1
omit					
Total	23	23	23	23	22

Answer B Percent Correct

L	ML	M	MH	H
48	52	65	83	91

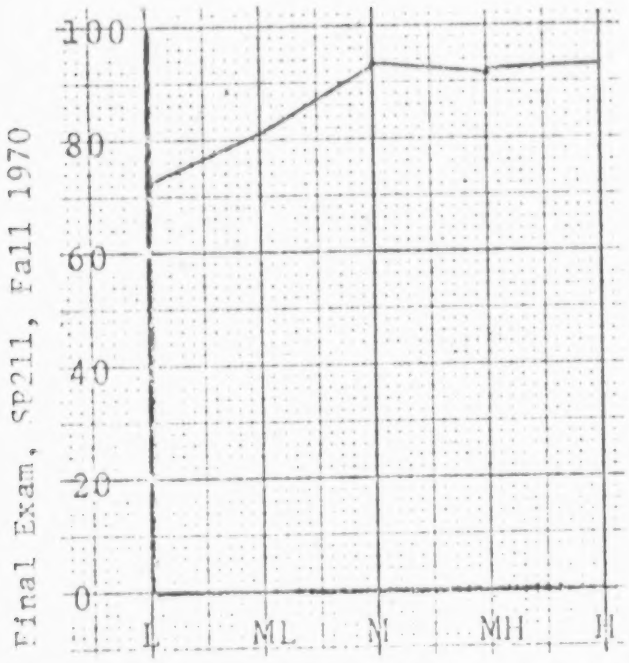
SELF-PACED

	L	ML	M	MH	H
(a)	5	1	3	1	1
(b)	8	15	12	16	18
(c)	2	1	1	1	-
(d)	2	-	-	1	-
(e)	3	3	4	1	1
omit					
Total	20	20	20	20	20

Answer B Percent Correct

L	ML	M	MH	H
40	75	60	80	90

TOTAL STUDENTS: Exam Question # 11 (of 55)



	L	ML	M	MH	H
(a)	--	--	-	-	-
(b)	9	4	1	3	1
(c)	2	2	1	1	-
(d)	31	35	40	39	39
(e)	1	2	1	-	2
omit					
Total	43	43	43	43	42

Answer 10 Percent Correct

L	ML	M	MH	H
72	81	93	91	93

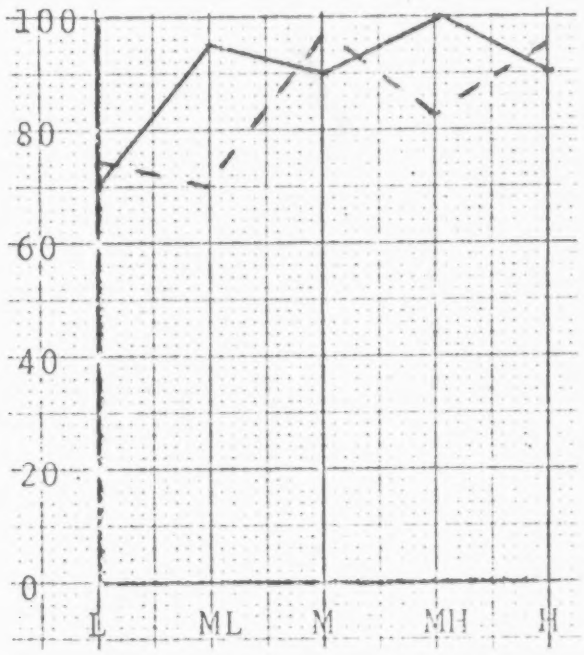
****

Final Exam # 11 T.O. # 14

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970



COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"

CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	-	-	-	-	-
(b)	4	4	1	3	-
(c)	2	1	-	1	-
(d)	17	16	22	19	21
(e)	-	2	-	-	1
omit					
Total	23	23	23	23	22

Answer D Percent Correct

L	ML	M	MH	H
74	70	96	83	95

SELF-PACED

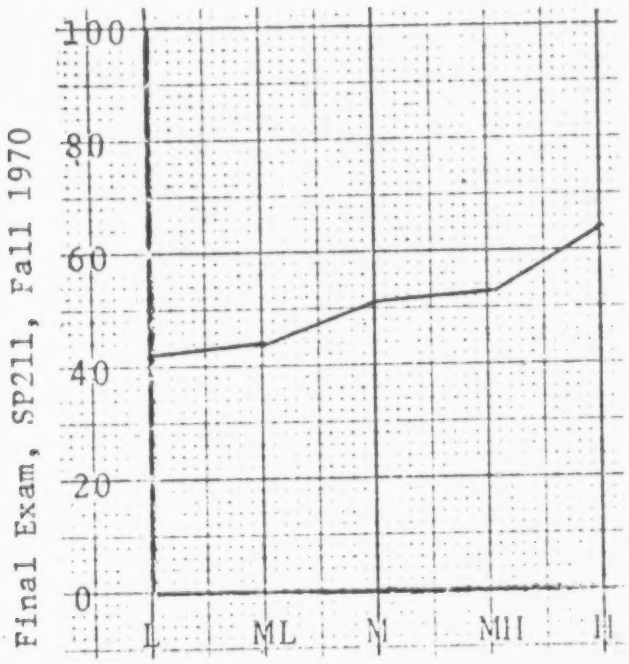
	L	ML	M	MH	H
(a)	-	-	-	-	-
(b)	5	-	-	-	1
(c)	-	1	1	-	-
(d)	14	19	18	20	18
(e)	1	-	1	-	1
omit					
Total	20	20	20	20	20

Answer D Percent Correct

L	ML	M	MH	H
70	95	90	100	90

C11

TOTAL STUDENTS: Exam Question # 12 (of 55)



	L	ML	M	MH	H
(a)	-	-	-	-	-
(b)	6	3	6	6	3
(c)	3	2	1	1	-
(d)	18	19	22	23	27
(e)	16	19	14	13	12
omit					
Total	43	43	43	43	42

Answer D Percent Correct

L	ML	M	MH	H
42	44	51	53	64

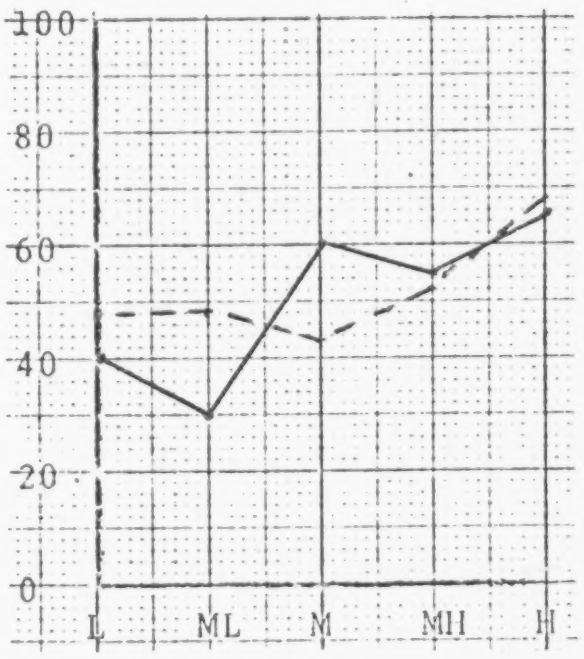
****

Final Exam # 12 T.O. # 3

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970



COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"

CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	-	-	-	-	-
(b)	5	1	3	3	1
(c)	-	-	-	-	-
(d)	11	11	10	12	15
(e)	7	11	10	8	6
omit					
Total	23	23	23	23	22

Answer D Percent Correct

L	ML	M	MH	H
48	48	43	52	68

SELF-PACED

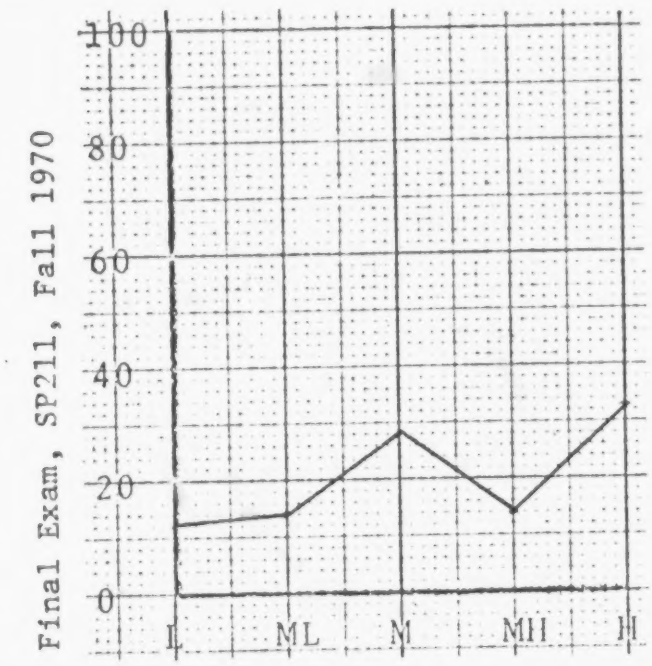
	L	ML	M	MH	H
(a)	-	-	-	-	-
(b)	1	4	1	4	1
(c)	2	3	1	1	-
(d)	8	6	12	11	13
(e)	9	7	6	4	6
omit					
Total	20	20	20	20	20

Answer D Percent Correct

L	ML	M	MH	H
40	30	60	55	65

C12

TOTAL STUDENTS: Exam Question # 13 (of 55)



	L	ML	M	MH	H
(a)	19	21	7	18	7
(b)	5	6	12	6	14
(c)	16	10	20	15	16
(d)	-	1	-	-	-
(e)	3	5	4	4	5
omit					
Total	43	43	43	43	42

Answer B Percent Correct

L	ML	M	MH	H
12	14	28	14	33

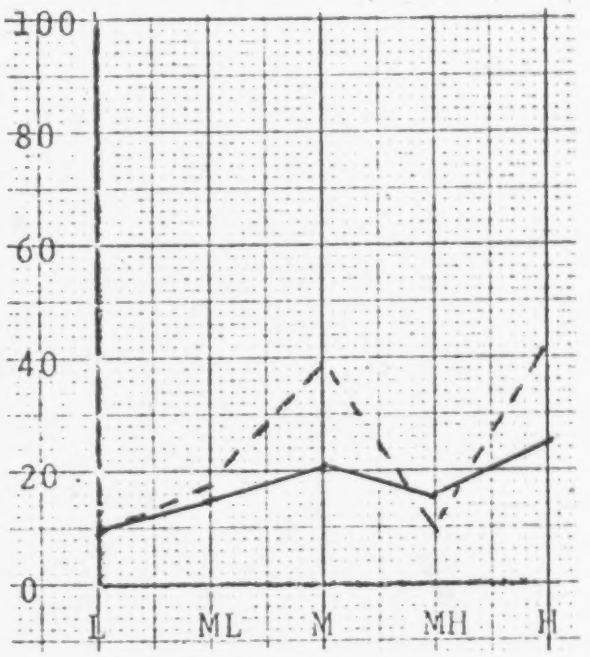
****

Final Exam # 13 T.O. # 17

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970



COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"

CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	11	11	4	14	6
(b)	2	4	9	2	9
(c)	7	3	8	5	3
(d)	-	1	-	-	-
(e)	3	4	2	2	4
omit					
Total	23	23	23	23	22

Answer B Percent Correct

L	ML	M	MH	H
9	17	39	9	41

SELF-PACED

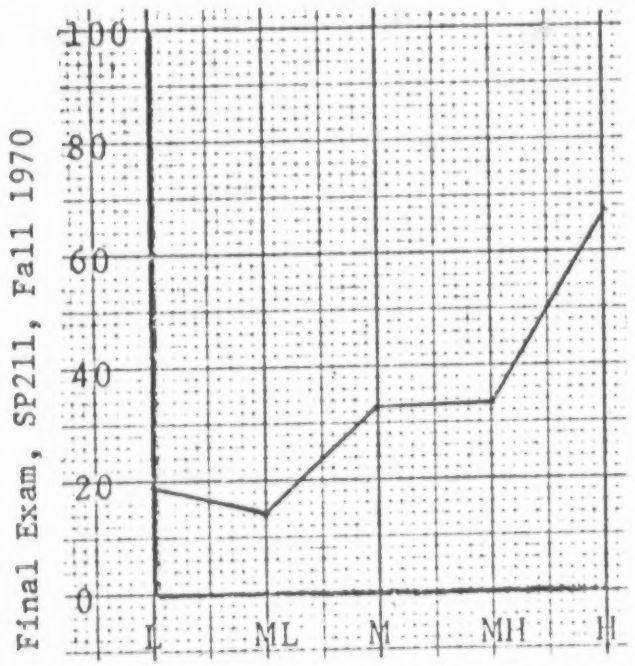
	L	ML	M	MH	H
(a)	8	6	7	4	1
(b)	2	3	4	3	5
(c)	9	10	8	11	13
(d)	-	-	-	-	-
(e)	1	1	1	2	1
omit					
Total	20	20	20	20	20

Answer B Percent Correct

L	ML	M	MH	H
10	15	20	15	25

C13

TOTAL STUDENTS: Exam Question # 14 (of 55)



	L	ML	M	MH	H
(a)	13	11	2	6	3
(b)	7	7	9	5	2
(c)	12	14	13	12	4
(d)	8	6	14	14	28
(e)	3	4	5	5	5
omit		1		1	
Total	43	43	43	43	42

Answer D Percent Correct

L	ML	M	MH	H
19	14	33	33	67

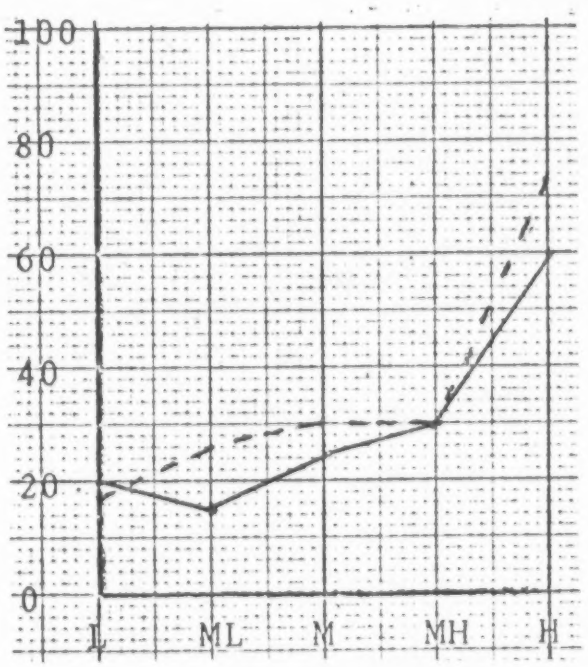
****

Final Exam # 14 T.O. # 19

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970



COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"

CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	7	6	2	5	3
(b)	3	6	3	4	1
(c)	7	3	8	4	1
(d)	4	6	7	7	16
(e)	2	1	3	2	1
omit		1		1	
Total	23	23	23	23	22

Answer D Percent Correct

L	ML	M	MH	H
17	26	30	30	73

SELF-PACED

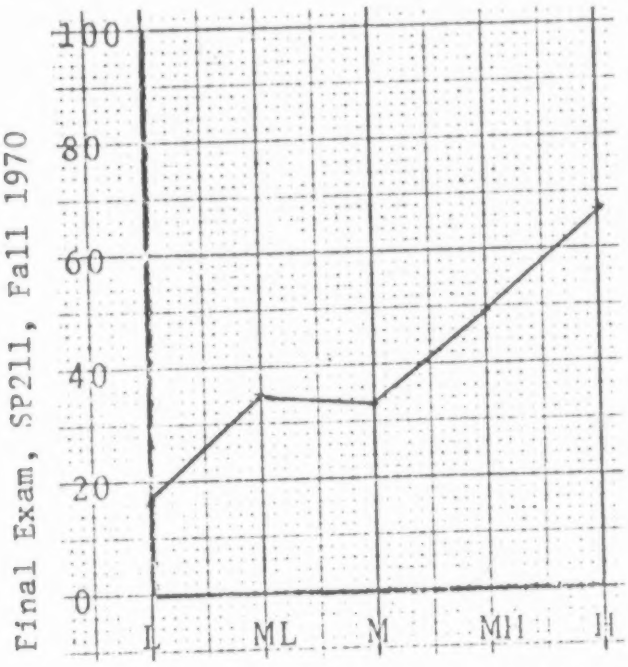
	L	ML	M	MH	H
(a)	5	6	-	1	-
(b)	4	4	3	1	1
(c)	6	4	11	8	3
(d)	4	3	5	6	12
(e)	1	3	1	4	4
omit					
Total	20	20	20	20	20

Answer D Percent Correct

L	ML	M	MH	H
20	15	25	30	60

C14

TOTAL STUDENTS: Exam Question # 15 (of 55)



	L	ML	M	MH	H
(a)	28	20	23	12	10
(b)	7	15	14	21	28
(c)	8	7	5	8	4
(d)	-	1	1	2	-
(e)	-	-	-	-	-
omit					
Total	43	43	43	43	42

Answer B Percent Correct

L	ML	M	MH	H
16	35	33	49	67

****

Final Exam # 15 T.O. # 20

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970

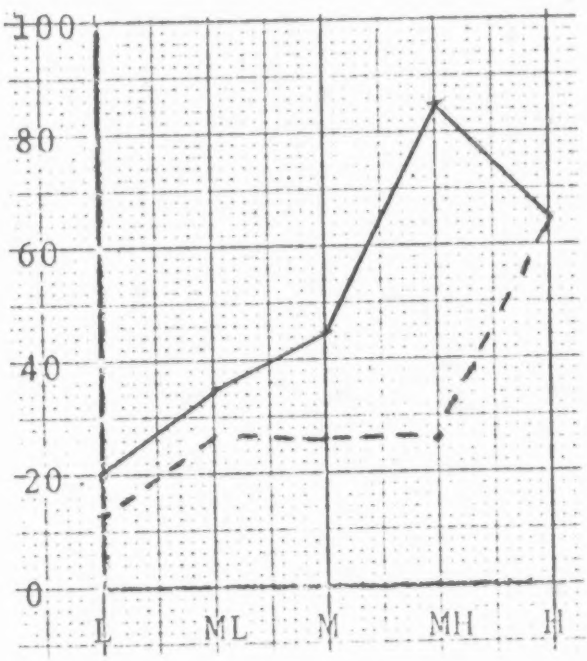
COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ——

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"



CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	14	12	12	9	5
(b)	3	6	6	6	14
(c)	6	5	4	6	3
(d)	-	-	1	2	-
(e)	-	-	-	-	-
omit					
Total	23	23	23	23	22

Answer B Percent Correct

L	ML	M	MH	H
13	26	26	26	64

SELF-PACED

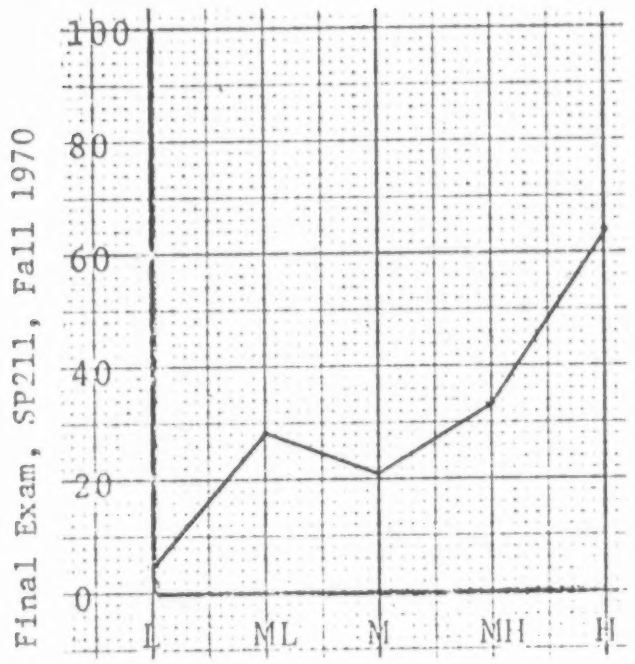
	L	ML	M	MH	H
(a)	13	10	10	2	6
(b)	4	7	9	17	13
(c)	3	3	-	1	1
(d)	-	-	1	-	-
(e)	-	-	-	-	-
omit					
Total	20	20	20	20	20

Answer B Percent Correct

L	ML	M	MH	H
20	35	45	85	65

C15

TOTAL STUDENTS: Exam Question # 16 (of 55)



	L	ML	M	MH	H
(a)	14	11	11	11	5
(b)	2	12	9	14	27
(c)	13	5	9	7	2
(d)	9	4	6	8	5
(e)	5	11	7	2	3
omit			1	1	
Total	43	43	43	43	42

Answer B Percent Correct

L	ML	M	MH	H
5	28	21	33	64

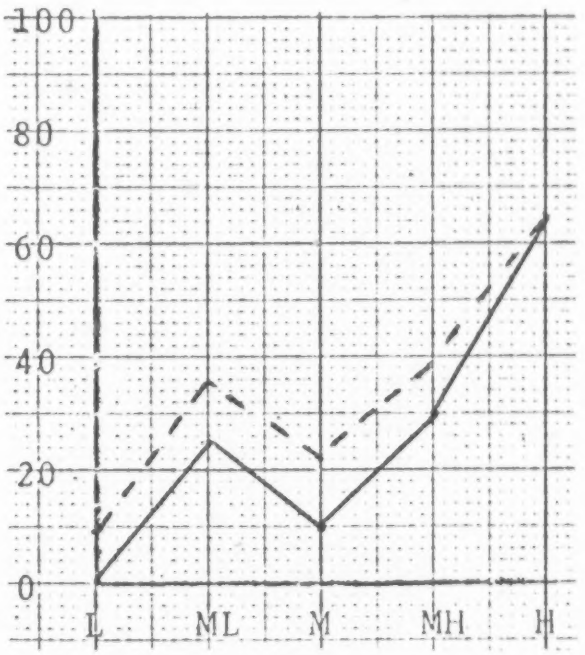
****

Final Exam # 16 T.O. # 19

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970



COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"

CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	10	5	6	6	3
(b)	2	8	5	9	14
(c)	5	3	4	3	2
(d)	2	3	4	3	3
(e)	4	4	4	1	-
omit				1	
Total	23	23	23	23	22

Answer B Percent Correct

L	ML	M	MH	H
9	35	22	39	64

SELF-PACED

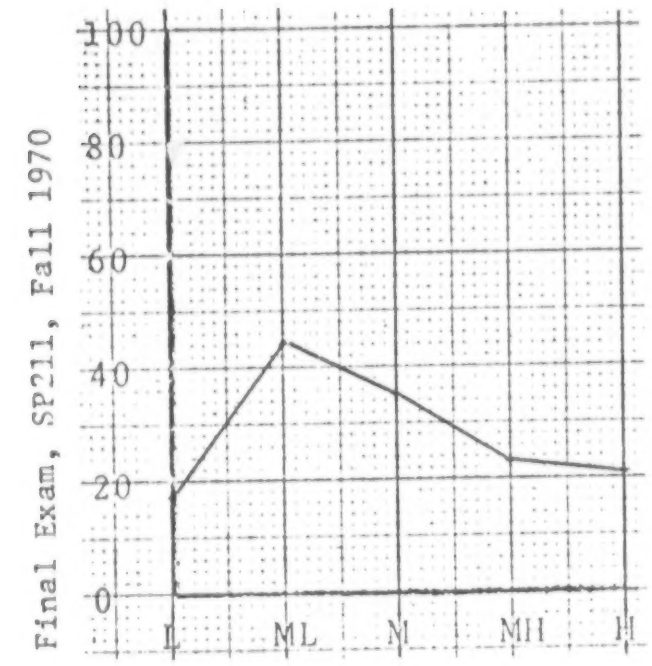
	L	ML	M	MH	H
(a)	5	7	3	5	2
(b)	-	5	2	6	13
(c)	7	3	5	4	-
(d)	7	-	4	4	2
(e)	1	5	5	1	3
omit			1		
Total	20	20	20	20	20

Answer B Percent Correct

L	ML	M	MH	H
0	25	10	30	65

C16

TOTAL STUDENTS: Exam Question # 17 (of 55)



	L	ML	M	MH	H
(a)	15	7	16	22	24
(b)	5	6	1	2	4
(c)	8	19	15	10	9
(d)	11	11	10	5	3
(e)	3	-	1	3	2
omit	1			1	
Total	43	43	43	43	42

Answer C Percent Correct

L	ML	M	MH	H
17	44	35	23	21

****

Final Exam # 17 T.O. # 27

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970

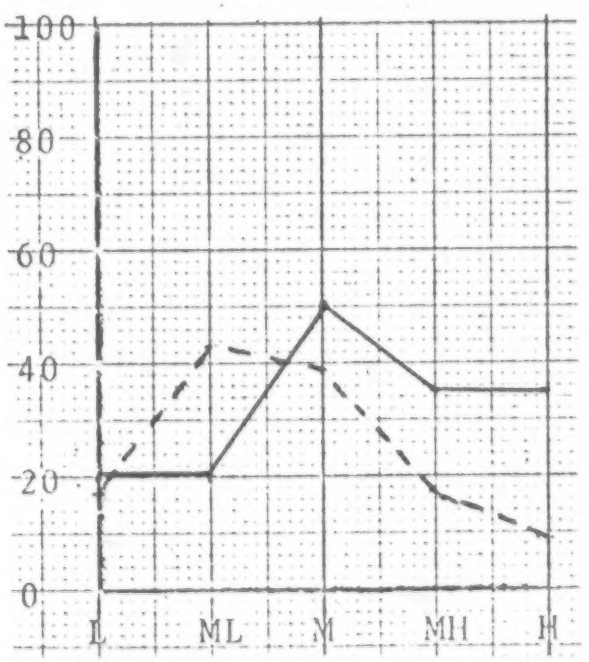
COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"



CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	8	3	7	14	16
(b)	4	3	1	-	2
(c)	4	10	9	4	2
(d)	5	6	6	3	1
(e)	2	1		1	1
omit				1	
Total	23	23	23	23	22

Answer C Percent Correct

L	ML	M	MH	H
17	43	39	17	9

SELF-PACED

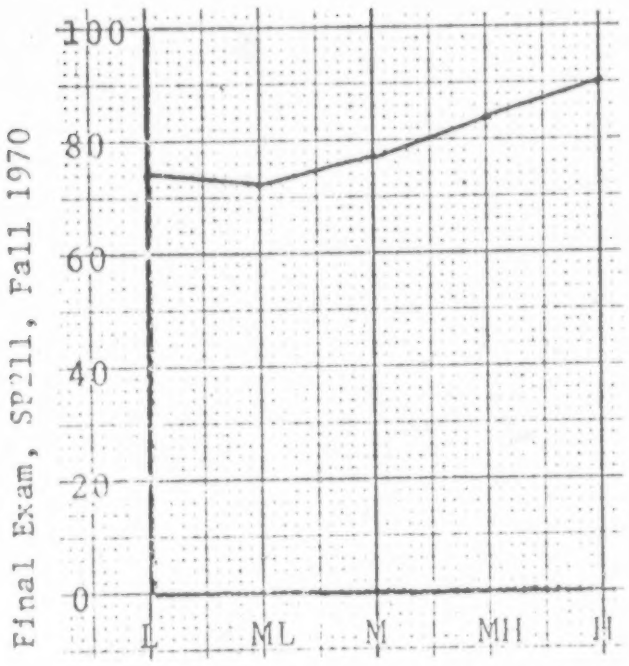
	L	ML	M	MH	H
(a)	6	9	6	8	7
(b)	2	2	-	2	2
(c)	4	4	10	7	7
(d)	6	5	4	1	3
(e)	1	-	-	2	1
omit	1				
Total	20	20	20	20	20

Answer C Percent Correct

L	ML	M	MH	H
20	20	50	35	35

C17

TOTAL STUDENTS: Exam Question # 18 (of 55)



	L	ML	M	MH	H
(a)	32	31	33	36	38
(b)	10	12	10	7	4
(c)	-	-	-	-	-
(d)	-	-	-	-	-
(e)	-	-	-	-	-
omit					
Total	43	43	43	43	42

Answer A Percent Correct

L	ML	M	MH	H
74	72	77	84	90

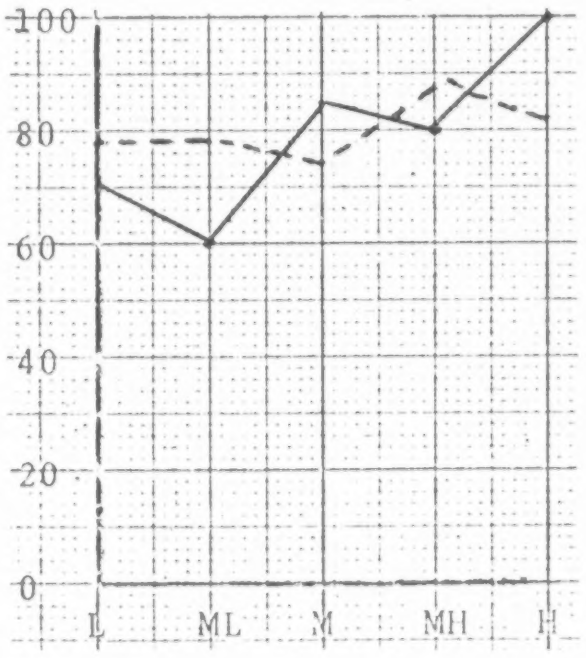
****

Final Exam # 18 T.O. # 24

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970



COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"

CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	18	18	17	20	18
(b)	4	5	6	3	4
(c)	-	-	-	-	-
(d)	-	-	-	-	-
(e)	1	-	-	-	-
omit					
Total	23	23	23	23	22

Answer A Percent Correct

L	ML	M	MH	H
78	78	74	87	82

SELF-PACED

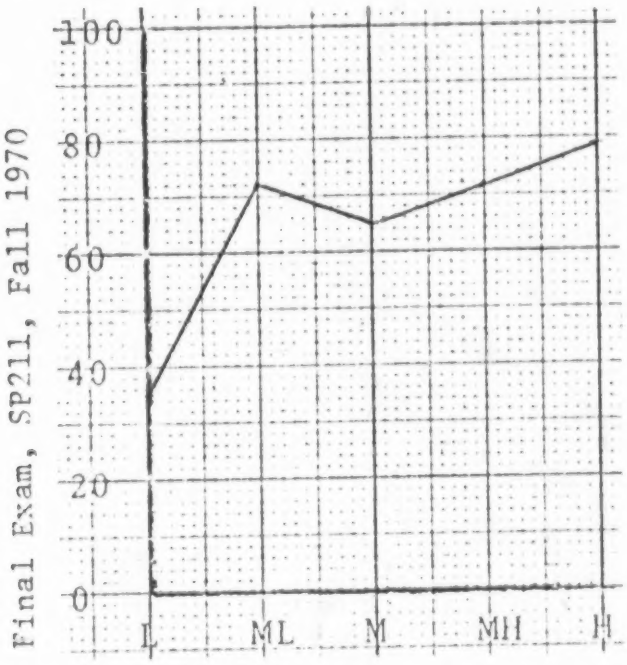
	L	ML	M	MH	H
(a)	14	12	17	16	20
(b)	6	8	3	4	-
(c)	-	-	-	-	-
(d)	-	-	-	-	-
(e)	-	-	-	-	-
omit					
Total	20	20	20	20	20

Answer A Percent Correct

L	ML	M	MH	H
70	60	85	80	100

C18

TOTAL STUDENTS: Exam Question # 19 (of 55)



	L	ML	M	MH	H
(a)	8	3	2	4	1
(b)	14	2	4	1	2
(c)	15	31	28	31	33
(d)	6	7	9	7	6
(e)	-	-	-	-	-
omit					
Total	43	43	43	43	42

Answer C Percent Correct

L	ML	M	MH	H
35	72	65	72	79

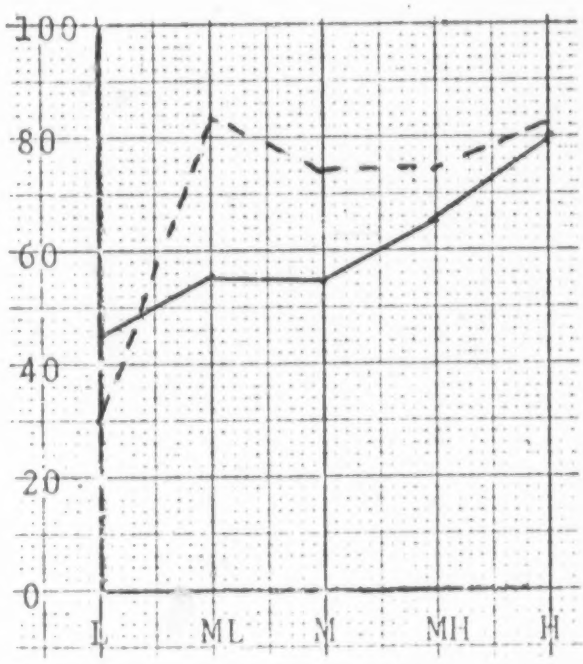
****

Final Exam # 19 T.O. # 27

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970



COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"

CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	6	1	1	4	-
(b)	5	1	1	-	1
(c)	7	19	17	17	18
(d)	5	2	4	2	3
(e)	-	-		-	-
omit					
Total	23	23	23	23	22

Answer C Percent Correct

L	ML	M	MH	H
30	83	74	74	82

SELF-PACED

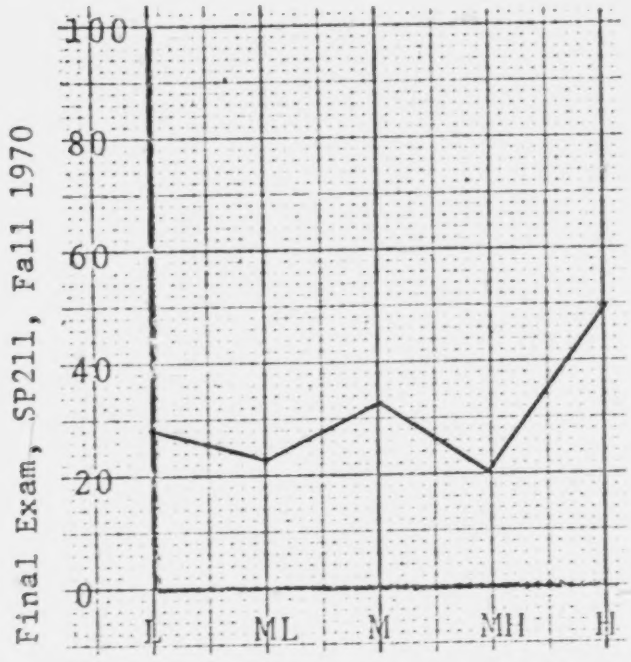
	L	ML	M	MH	H
(a)	2	2	1	-	1
(b)	8	2	3	1	1
(c)	9	11	11	13	16
(d)	1	5	5	6	2
(e)	-	-	-	-	-
omit					
Total	20	20	20	20	20

Answer C Percent Correct

L	ML	M	MH	H
45	55	55	65	80

C19

TOTAL STUDENTS: Exam Question # 20 (of 55)



	L	ML	M	MH	H
(a)	10	9	3	6	5
(b)	12	10	14	9	21
(c)	5	5	6	7	2
(d)	7	6	9	13	12
(e)	9	13	11	8	2
omit					
Total	43	43	43	43	42

Answer B Percent Correct

L	ML	M	MH	H
28	23	33	21	50

****

Final Exam # 20 T.O. # 31

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970

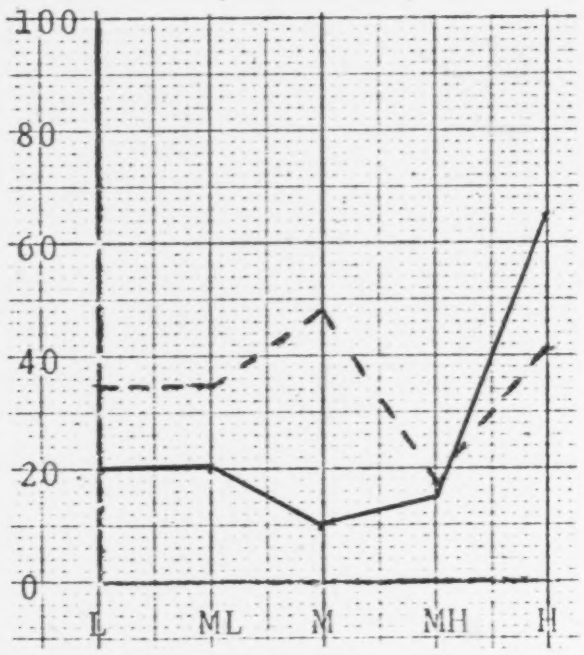
COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ——

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"



CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	4	3	-	4	3
(b)	8	8	11	4	9
(c)	3	2	2	3	1
(d)	3	2	7	10	8
(e)	5	8	3	2	1
omit					
Total	23	23	23	23	22

Answer B Percent Correct

L	ML	M	MH	H
35	35	48	17	41

SELF-PACED

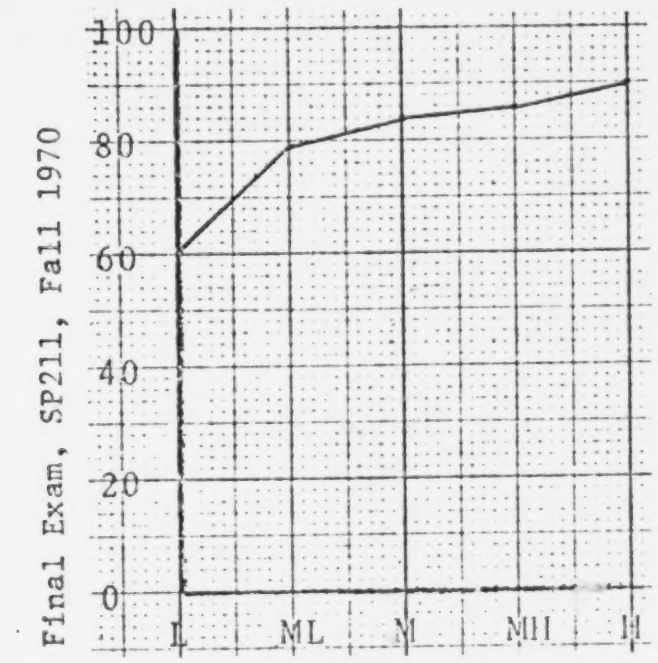
	L	ML	M	MH	H
(a)	6	5	4	2	2
(b)	4	4	2	3	13
(c)	1	3	4	5	1
(d)	5	3	2	4	3
(e)	4	5	8	6	1
omit					
Total	20	20	20	20	20

Answer B Percent Correct

L	ML	M	MH	H
20	20	10	15	65

C20

TOTAL STUDENTS: Exam Question # 21 (of 55)



	L	ML	M	MH	H
(a)	26	34	36	37	38
(b)	10	5	4	6	3
(c)	3	-	2	-	1
(d)	4	4	1	-	-
(e)	-	-	-	-	-
omit					
Total	43	43	43	43	42

Answer A Percent Correct

L	ML	M	MH	H
60	79	84	86	90

****

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970

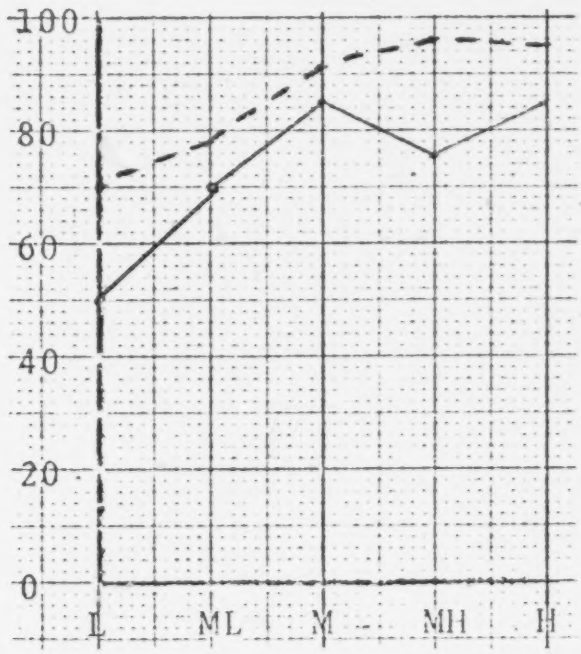
Final Exam # 21 T.O. # 31

COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -



(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"

CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	16	18	21	22	21
(b)	3	4	2	1	1
(c)	2	-	-	-	-
(d)	2	1	-	-	-
(e)	-	-	-	-	-
omit					
Total	23	23	23	23	22

Answer A Percent Correct

L	ML	M	MH	H
70	78	91	96	95

SELF-PACED

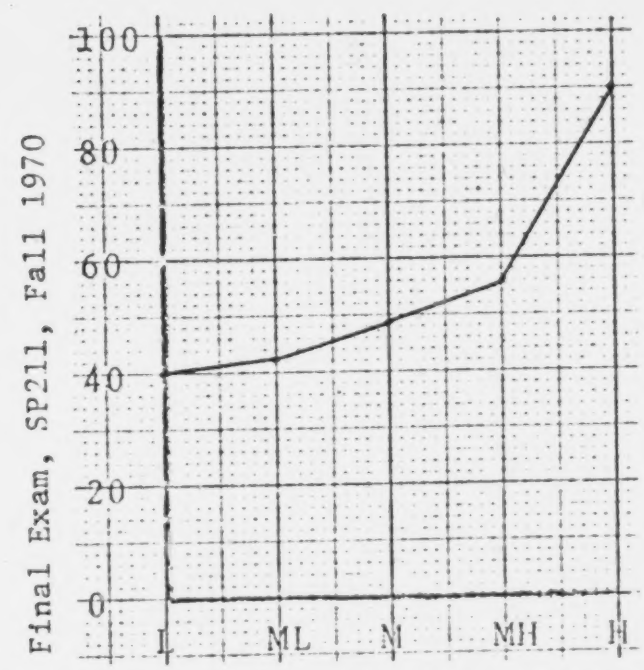
	L	ML	M	MH	H
(a)	10	14	17	15	17
(b)	7	2	1	5	2
(c)	1	-	2	-	1
(d)	2	4	-	-	-
(e)	-	-	-	-	-
omit					
Total	20	20	20	20	20

Answer A Percent Correct

L	ML	M	MH	H
50	70	85	75	85

C21

TOTAL STUDENTS: Exam Question # 22 (of 55)



	L	ML	M	MH	H
(a)	2	2	3	3	1
(b)	17	18	21	24	38
(c)	15	16	18	13	3
(d)	8	7	1	1	-
(e)	1	-	-	1	-
omit				1	
Total	43	43	43	43	42

Answer B Percent Correct

L	ML	M	MH	H
40	42	49	56	90

****

Final Exam # 22 T.O. # 33

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970

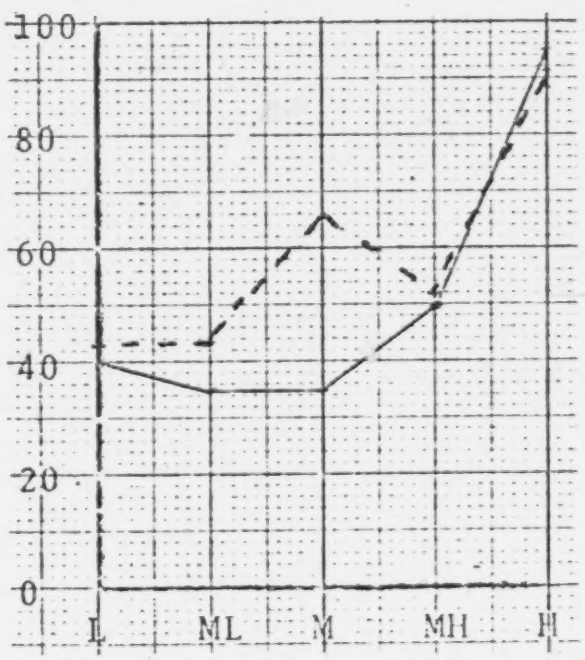
COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"



CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	2	1	-	3	1
(b)	10	10	15	12	20
(c)	7	9	8	7	1
(d)	3	3	-	-	-
(e)	1	-	-	1	-
omit					
Total	23	23	23	23	22

Answer B Percent Correct

L	ML	M	MH	H
43	43	65	52	91

SELF-PACED

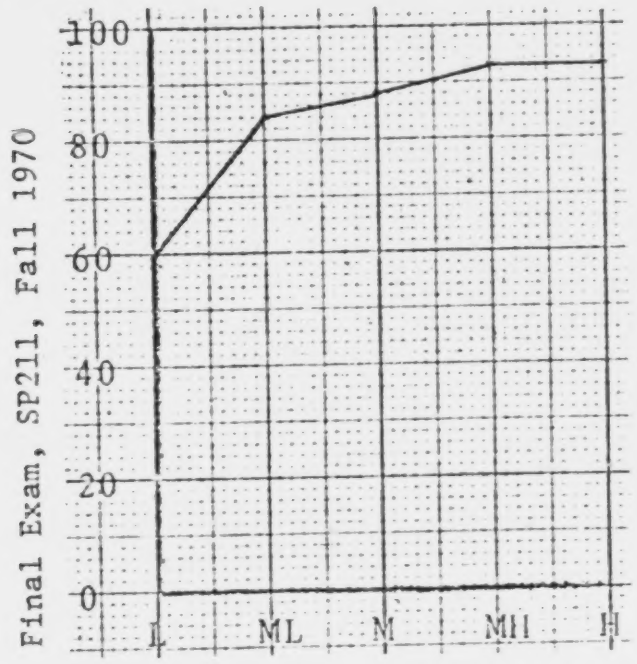
	L	ML	M	MH	H
(a)	-	1	3	-	-
(b)	8	7	7	10	19
(c)	7	10	8	7	1
(d)	5	2	2	2	-
(e)	-			-	-
omit				1	
Total	20	20	20	20	20

Answer B Percent Correct

L	ML	M	MH	H
40	35	35	50	95

C22

TOTAL STUDENTS: Exam Question # 23 (of 55)



	L	ML	M	MH	H
(a)	3	1	-	-	-
(b)	9	3	3	2	2
(c)	6	3	2	1	1
(d)	25	36	38	40	39
(e)	-	-	-	-	-
omit					
Total	43	43	43	43	42

Answer D Percent Correct

L	ML	M	MH	H
58	84	88	93	93

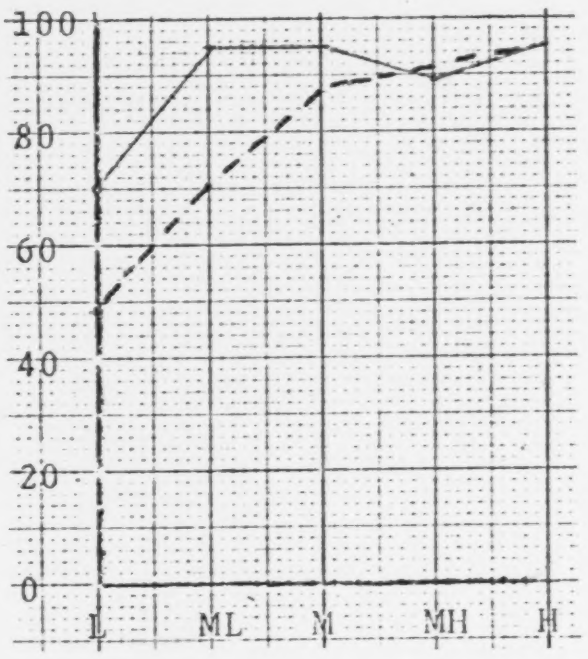
****

Final Exam # 23 T.O. # 37

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970



COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"

CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	2	-	-	-	-
(b)	8	3	2	2	1
(c)	2	4	1	-	-
(d)	11	16	20	21	21
(e)	-	-	-	-	-
omit					
Total	23	23	23	23	22

Answer D Percent Correct

L	ML	M	MH	H
48	70	87	91	95

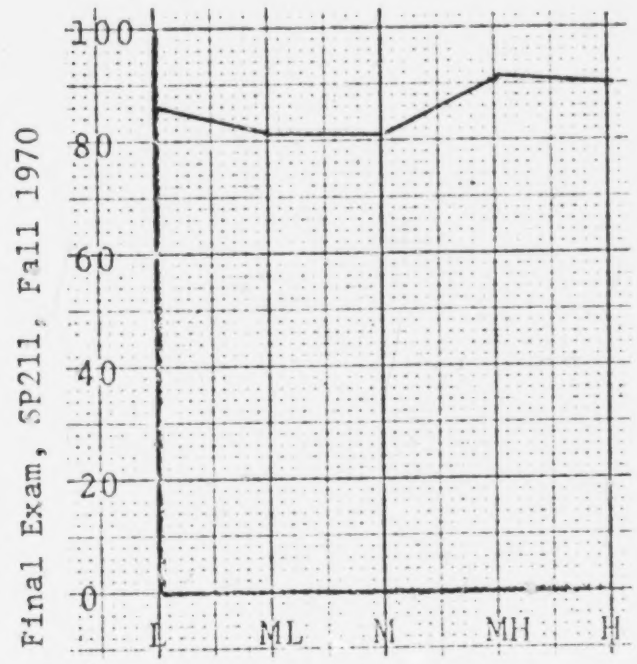
SELF-PACED

	L	ML	M	MH	H
(a)	1	1	-	-	-
(b)	1	-	1	1	-
(c)	4	-	-	1	1
(d)	14	19	19	18	1
(e)	-	-	-	-	-
omit					
Total	20	20	20	20	20

Answer D Percent Correct

L	ML	M	MH	H
70	95	95	90	95

TOTAL STUDENTS: Exam Question # 24 (of 55)



	L	ML	M	MH	H
(a)	37	35	35	39	38
(b)	6	8	8	4	4
(c)	-	-	-	-	-
(d)	-	-	-	-	-
(e)	-	-	-	-	-
omit					
Total	43	43	43	43	42

Answer A Percent Correct

L	ML	M	MH	H
86	81	81	91	90

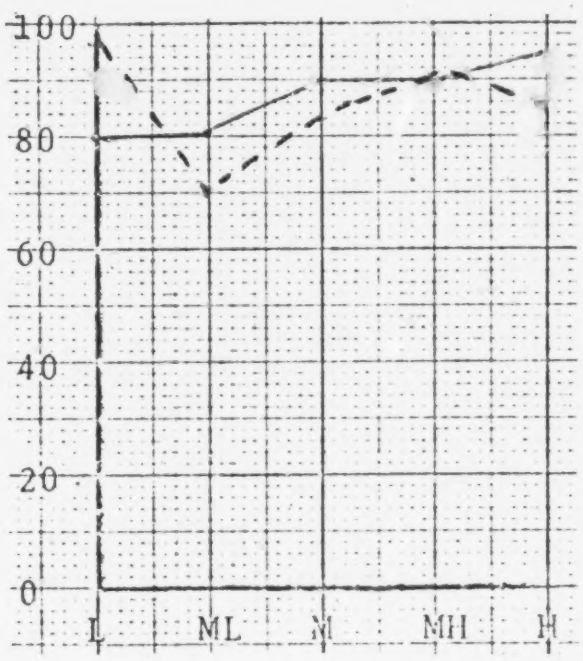
****

Final Exam # 24 T.O. # 28

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970



COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"

CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	22	16	19	21	19
(b)	1	7	4	2	3
(c)	-	-	-	-	-
(d)	-	-	-	-	-
(e)	-	-	-	-	-
omit					
Total	23	23	23	23	22

Answer A Percent Correct

L	ML	M	MH	H
96	70	83	91	86

SELF-PACED

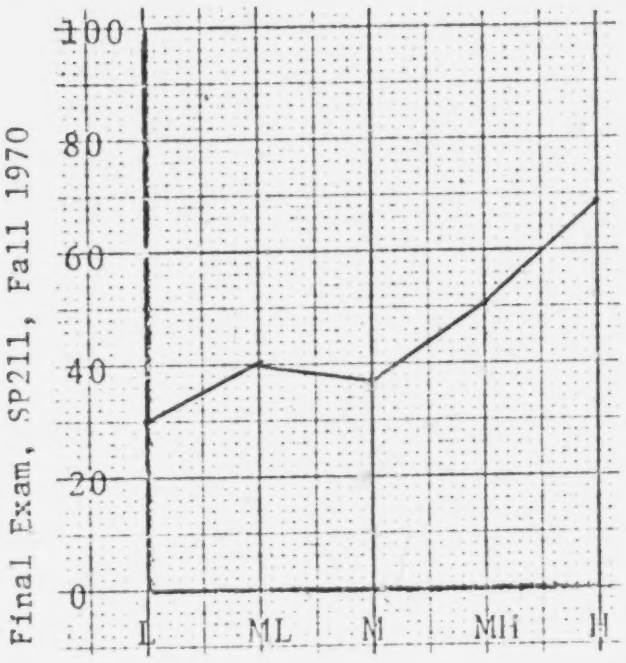
	L	ML	M	MH	H
(a)	16	16	18	18	17
(b)	4	4	2	2	1
(c)	-	-	-	-	-
(d)	-	-	-	-	-
(e)	-	-	-	-	-
omit					
Total	20	20	20	20	20

Answer A Percent Correct

L	ML	M	MH	H
80	80	90	90	95

C24

TOTAL STUDENTS: Exam Question # 25 (of 55)



	L	ML	M	MH	H
(a)	5	3	7	1	6
(b)	13	17	16	22	29
(c)	10	13	16	10	5
(d)	13	6	2	9	1
(e)	1	4	2	-	-
omit	1			1	1
Total	43	43	43	43	42

Answer B Percent Correct

L	ML	M	MH	H
30	40	37	51	69

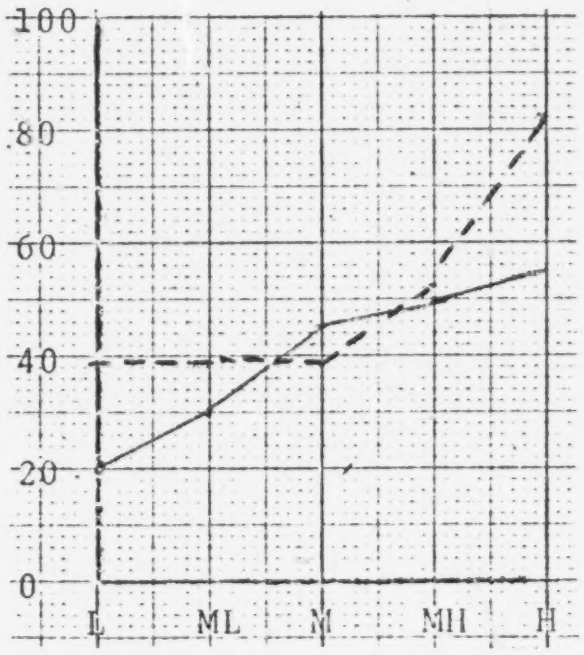
****

Final Exam # 25 T.O. # 37

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970



COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"

CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	3	1	5	-	1
(b)	9	9	9	12	18
(c)	4	8	6	5	2
(d)	6	4	1	4	1
(e)	1	1	2	-	-
omit				2	
Total	23	23	23	23	22

Answer B Percent Correct

L	ML	M	MH	H
39	39	39	52	82

SELF-PACED

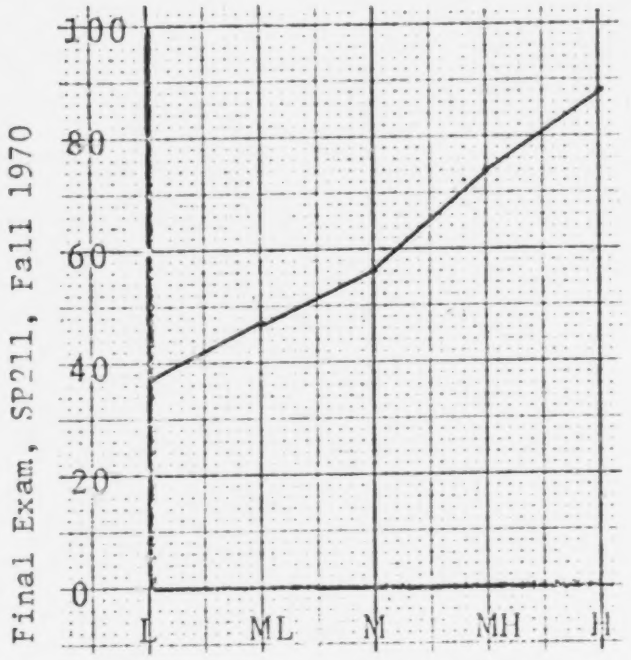
	L	ML	M	MH	H
(a)	3	1	2	1	5
(b)	4	6	9	10	11
(c)	6	7	8	5	3
(d)	6	4	-	4	1
(e)	-	2	1		-
omit	1				
Total	20	20	20	20	20

Answer B Percent Correct

L	ML	M	MH	H
20	30	45	50	55

C25

TOTAL STUDENTS: Exam Question # 26 (of 55)



	L	ML	M	MH	H
(a)	9	8	5	2	1
(b)	16	20	24	32	37
(c)	1	2	2	1	-
(d)	4	2	4	-	-
(e)	12	11	8	8	4
omit	1				
Total	43	43	43	43	42

Answer B Percent Correct

L	ML	M	MH	H
37	47	56	74	88

****

Final Exam # 26 T.O. # 14

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970

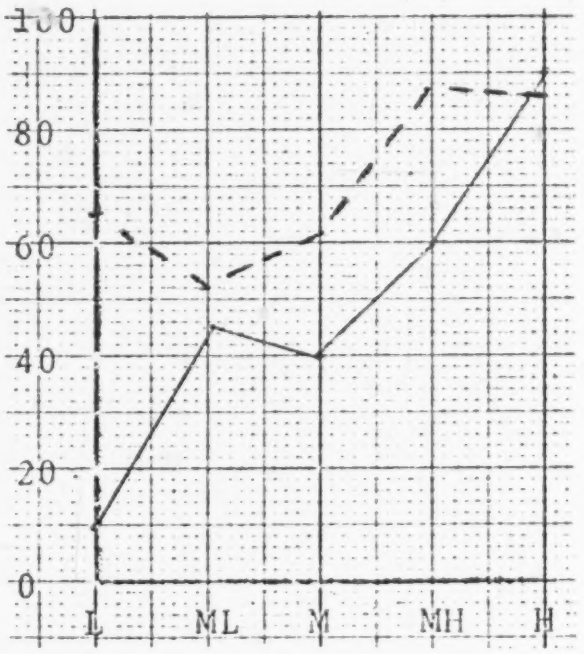
COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"



CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	2	3	2	1	-
(b)	15	12	14	20	19
(c)	-	2	1	1	-
(d)	1	2	1	-	-
(e)	5	4	5	1	3
omit					
Total	23	23	23	23	22

Answer B Percent Correct

L	ML	M	MH	H
65	52	61	87	86

SELF-PACED

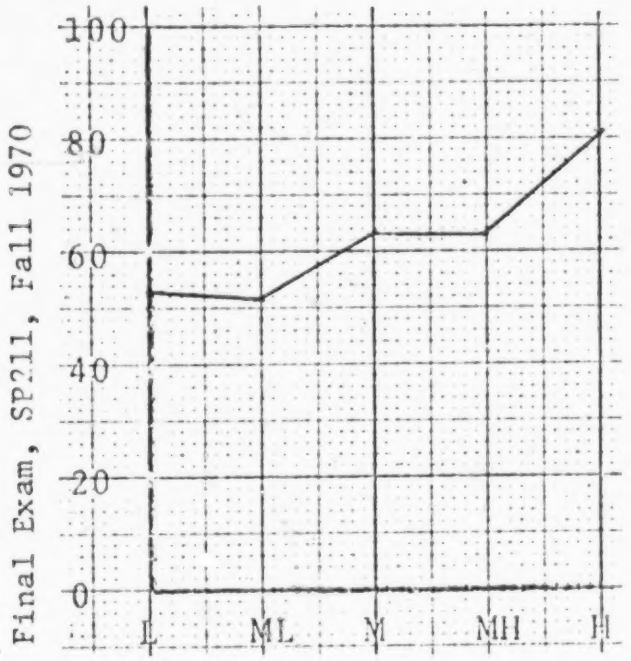
	L	ML	M	MH	H
(a)	7	4	4	1	1
(b)	2	9	8	12	18
(c)	1	-	1	-	-
(d)	3	-	3	-	-
(e)	6	7	4	7	1
omit	1				
Total	20	20	20	20	20

Answer B Percent Correct

L	ML	M	MH	H
10	45	40	60	90

C26

TOTAL STUDENTS: Exam Question # 34 (of 55)



	L	ML	M	MH	H
(a)	16	16	15	11	7
(b)	-	1	-	-	-
(c)	23	22	27	27	34
(d)	4	4	1	5	1
(e)	-	-	-	-	-
omit					
Total	43	43	43	43	42

Answer C Percent Correct

L	ML	M	MH	H
53	51	63	63	81

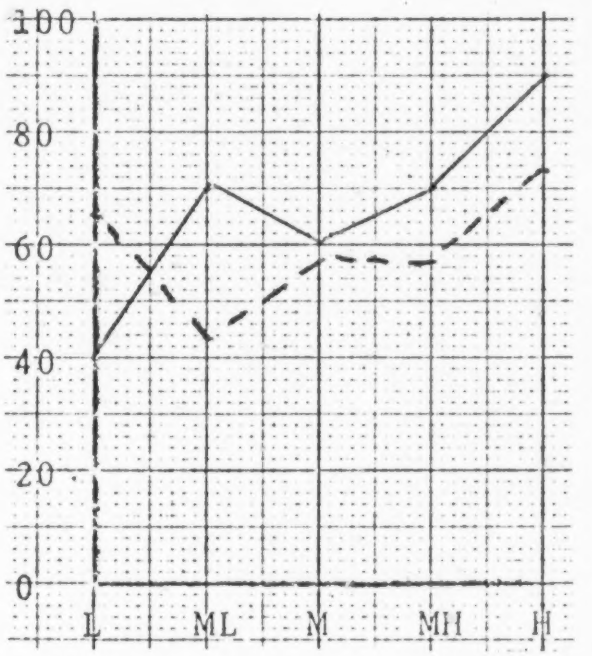
****

USNA FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970

Final Exam # 34 T.O. # 48



COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"

CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	8	12	10	7	5
(b)	-	-	-	-	-
(c)	15	10	13	13	16
(d)	-	1	-	3	1
(e)	-	-	-	-	-
omit					
Total	23	23	23	23	22

Answer C Percent Correct

L	ML	M	MH	H
65	43	57	57	73

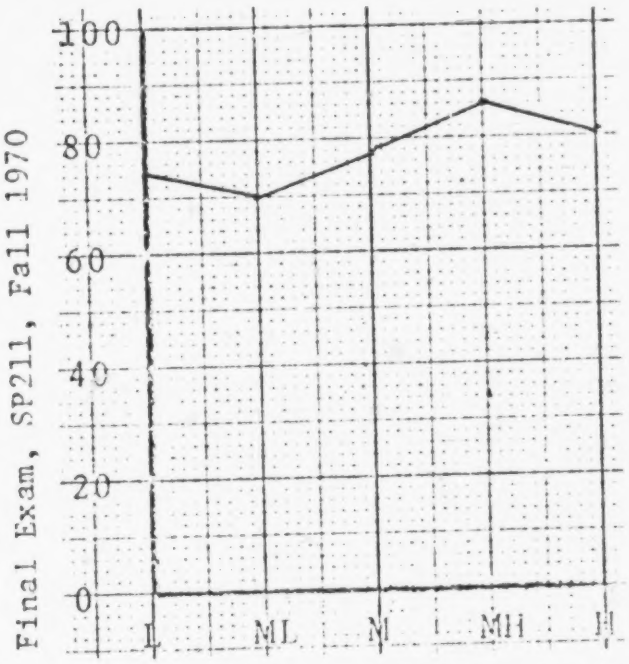
SELF-PACED

	L	ML	M	MH	H
(a)	8	4	5	4	2
(b)	-	1	-	-	-
(c)	8	14	12	14	18
(d)	4	1	3	2	-
(e)	-	-	-	-	-
omit					
Total	20	20	20	20	20

Answer C Percent Correct

L	ML	M	MH	H
40	70	60	70	90

TOTAL STUDENTS: Exam Question # 35 (of 55)



	L	ML	M	MH	H
(a)	3	-	-	-	-
(b)	4	4	4	2	1
(c)	4	6	6	3	3
(d)	32	30	33	37	34
(e)	-	3	-	1	4
omit					
Total	43	43	43	43	42

Answer D Percent Correct

L	ML	M	MH	H
74	70	77	86	81

****

Final Exam # 35 T.O. # 42

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970

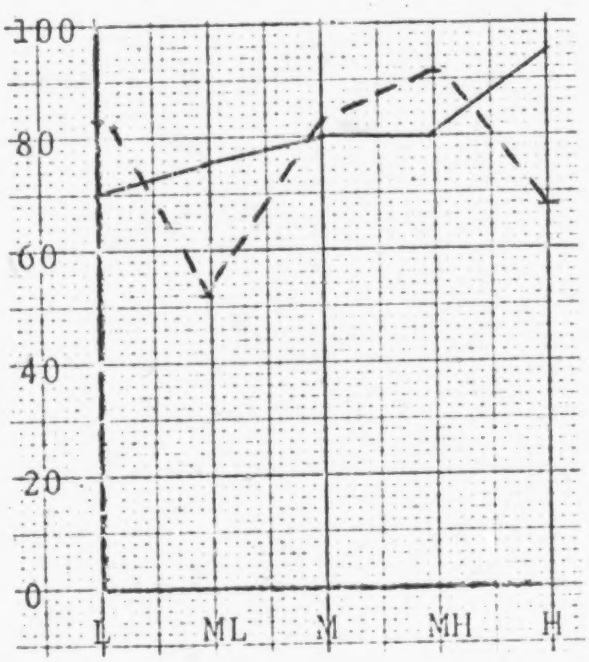
COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ———

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"



CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	-	-	-	-	-
(b)	3	4	1	-	-
(c)	1	4	3	2	3
(d)	19	12	19	21	15
(e)	-	3	-	-	4
omit					
Total	23	23	23	23	22

Answer D Percent Correct

L	ML	M	MH	H
83	52	83	91	68

SELF-PACED

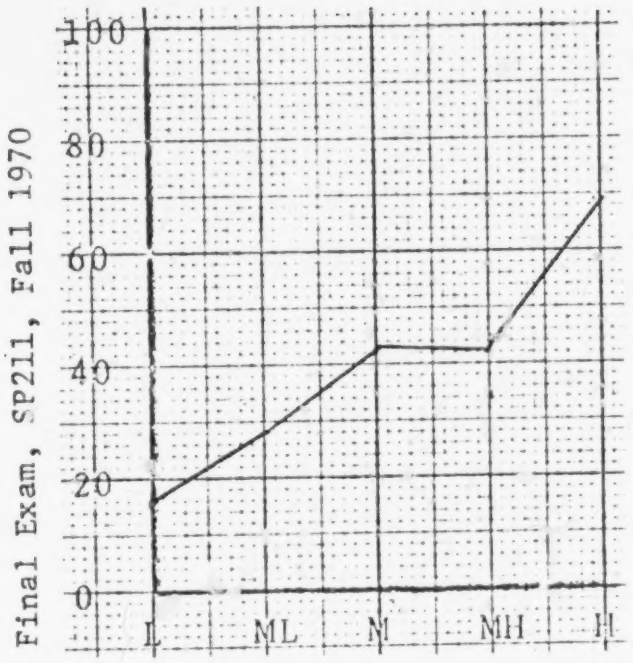
	L	ML	M	MH	H
(a)	2	1	-	-	-
(b)	1	-	3	2	
(c)	3	4	1	1	
(d)	14	15	16	16	17
(e)		-	-	1	-
omit					
Total	20	20	20	20	20

Answer D Percent Correct

L	ML	M	MH	H
70	75	80	80	95

C28

TOTAL STUDENTS: Exam Question # 36 (of 55)



	L	ML	M	MH	H
(a)	8	5	1	4	3
(b)	8	9	6	3	1
(c)	7	12	18	18	29
(d)	16	12	12	14	7
(e)	4	5	6	3	1
omit				1	1
Total	43	43	43	43	42

Answer C Percent Correct

L	ML	M	MH	H
16	28	42	42	69

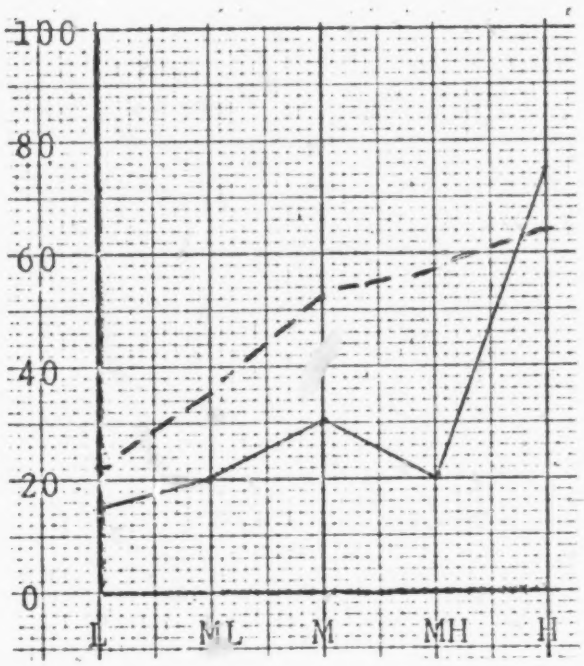
****

Final Exam # 36 T.O. # 43

USNA - FINAL EXAMINATION - PHYSICS SP211

(55 Total Questions)

FALL SEMESTER, 1970



COMPARATIVE PERFORMANCE

Key:

Student-Managed Sections ——

Conventional Sections - - - -

(Note: Exam Questions reflecting only answers A and B for student response represent questions that are "TRUE-FALSE"

CONVENTIONAL CLASSROOM SECTIONS

	L	ML	M	MH	H
(a)	5	3	-	2	-
(b)	4	3	5	2	1
(c)	5	8	12	13	14
(d)	8	6	3	4	5
(e)	1	3	3	1	1
omit				1	1
Total	23	23	23	23	22

Answer C Percent Correct

L	ML	M	MH	H
22	35	52	57	64

SELF-PACED

	L	ML	M	MH	H
(a)	3	1	2	2	3
(b)	4	5	2	1	-
(c)	3	4	6	4	15
(d)	8	6	8	11	2
(e)	2	4	2	2	-
omit					
Total	20	20	20	20	20

Answer C Percent Correct

L	ML	M	MH	H
15	20	30	20	75

C29

APPENDIX D

STUDENT QUESTIONNAIRE

The questionnaire was devised by Academy faculty members. It was given in January 1971 to students of the Fall '70 semester. Eighty-two students who had complete background information are included in the statistics.

Directions: Please answer the following questions on the mark-sense card which has your name on it.

1. What did you think of the student-paced laboratory periods?

A.	a real experience	12
B.	enjoyable	50
C.	no difference	10
D.	not enough guidance	5
E.	learned little	5

2. How many hours, on the average, did you spend per experiment?

A.	less than 1 hour	3
B.	1 - 2 hours	37
C.	2 - 3 hours	34
D.	3 - 4 hours	8
E.	over 4 hours	0

3. Were the laboratory experiment guides detailed enough for you to understand the principles involved?

A.	crystal clear	2
B.	clear	22
C.	cloudy in parts	50
D.	confusing	6
E.	didn't understand the principles	2

4. Were the number of experiments available at any one time adequate?

A.	need more up longer	22
B.	adequate	56
C.	need only 1 at a time	2
No response		(2)

5. I _____ have all physics labs in the self-paced format.

A.	strongly would like	45
B.	would rather	26
C.	no preference	5
D.	would rather not	6
E.	would not want to	0

6. Did the Problem and Solution Book provide adequate preparation for the Progress Checks?

A.	very good preparation	3
B.	good preparation	25
C.	adequate preparation	39
D.	poor preparation	13
E.	poor preparation	2

7. The amount of material covered in the course should be:

A. greatly increased	0
B. increased	2
C. maintained	63
D. decreased	17
E. greatly decreased	0

8. Compared to other science classes that I have taken at the Academy I think this class is

A. much easier	0
B. easier	9
C. about the same	30
D. harder	32
E. much harder	10
No response	(1)

9. Because of the method of material presentation compared to the "conventional" method of lecturing I believe I learned:

A. much more	0
B. more	20
C. about the same	20
D. less	29
E. much less	12
No response	(1)

10. To what degree were the mechanical steps (i.e., the magic pen, flipping pages, using the video tape recorder) a hindrance to your learning the material

A. a great hindrance	6
B. a hindrance	20
C. no hindrance	32
D. added some variety	20
E. actually enjoyable	4

11. As a way of organizing a course, I think that letting students pace themselves and manage their own progress is:

A. extremely beneficial	3
B. very beneficial	30
C. adequate	24
D. not very beneficial	22
E. useless	3

12. If I were to take another course in science or math, I would prefer student pacing to be:

A.	completely free	2
B.	less restrained	10
C.	the same	34
D.	more restricted	24
E.	abolished	12

13. I believe that I was able to schedule my own time:

A.	very profitably	6
B.	profitably	12
C.	adequately	28
D.	less profitably	30
E.	very poorly	6

14. As a result of student-pacing, the amount of time I was able to spend on other subjects was:

A.	much more	4
B.	more	35
C.	about the same	20
D.	less	20
E.	much less	3

15. Were the questions and information in the Problem and Solution Books helpful in understanding the objectives?

A.	extremely helpful	4
B.	very helpful	26
C.	adequate	32
D.	not very helpful	18
E.	useless	2

16. Did the questions in the Progress Checks require a greater or lesser degree of understanding than you expected on the basis of the stated objectives in the Study Guide?

A.	much greater understanding	13
B.	slightly greater	42
C.	exactly the same	20
D.	slightly less	6
E.	much less	1

17. Did you find the Problem and Solution Book helpful in preparing for Quarterly Diagnostic Tests?

A.	very valuable	11
B.	helpful	33
C.	so-so	23
D.	not very helpful	10
E.	wasted effort	5

18. Was the material presented on the TV tapes adequately explained?

A. very clear	2
B. clear	15
C. adequately clear	43
D. poorly explained	11
E. unuseable	5
No response	(6)

19. Did seeing the physics phenomenon demonstrated on TV aid in your understanding of the concept?

A. extremely helpful	2
B. very helpful	8
C. adequate	40
D. not very helpful	22
E. useless	4
No response	(6)

20. I made use of the TV

A. as often as possible	1
B. about once each week	3
C. occasionally	23
D. rarely	31
E. never	24

21. The use of "Talking Books" and the audio tapes was

A. very helpful	5
B. helpful	19
C. adequate	37
D. not very helpful	13
E. useless	7
No response	(1)

22. Using the "Illustrated Book" is

A. valuable	6
B. helpful	15
C. OK	35
D. not very helpful	16
E. wasted effort	7
No response	(3)

23. Could the Problem and Solution Book questions be answered without reading any references

A. always	2
B. most of the time	22
C. sometimes	42
D. seldom	14
E. never	2

24. Did you study physics outside the classroom?

A.	over 6 hours per week	11
B.	3 - 6 hours per week	32
C.	1 - 3 hours per week	33
D.	seldom	6
E.	never	0

25. Would specific review lectures by the instructor be helpful?

A.	very helpful	43
B.	helpful	26
C.	OK	7
D.	wouldn't be too helpful	5
E.	not needed	1

The next five questions refer to the following media:

A. Text
B. Instructor
C. TV Tape
D. Problem & Solution Book
E. Talking Book/Illustrated Book

26. Of the above five media which did you find most effective in learning physics?

A.	15
B.	22
C.	1
D.	40
E.	4

27. Which did you find second most effective?

A.	29
B.	23
C.	1
D.	2[illegible]
E.	4

28. Which did you find third most effective?

A.	24
B.	25
C.	5
D.	11
E.	17

29. Which did you find fourth most effective?

A.	10
B.	9
C.	33
D.	5
E.	23
No response	(2)

30. Which did you find least effective?

A.	7
B.	5
C.	36
D.	2
E.	29
No response	(3)

31. When I do not know an answer to a question in the Problem and Solution Book, I most frequently

A.	make a random guess.	17
B.	check my text or get help before starting.	12
C.	try to pick the most reasonable answer based on dimensions and "feel" and other factors that I reason out.	45
D.	thumb thru and try to find the correct answer in the back of the book.	8

32. Based on my knowledge of my own habits and desires, the Problem and Solution Book:

A.	forces me to work more problems than I ordinarily would in a course like this.	46
B.	occupies the time I would rather be spending on problems from a textbook.	11
C.	lets me off the hook because I would normally spend more time working problems on my own, but I feel I can quit when I finish the Problem and Solution Book.	25
D.	takes only part of the time I spend solving problems; I do extra problems from other sources.	0

33. Not many students seem to use the talking book or illustrated book. If you never or seldon use them, why is this so?

A. They are very boring.	15
B. They are too much trouble to use.	34
C. They are not related to what I am tested on.	2
D. They use odd notations and language that confuse me.	4
E. I use them.	25
No response	(2)

34. Do you learn more or less from the TV tapes compared to a live lecture of the same length without a question period?

A. much more	0
B. somewhat more	8
C. about the same	24
D. somewhat less	26
E. much less	21
No response	(3)

35. Do you feel an instructor is needed in the classroom?

A. all the time	25
B. most of the time	31
C. sometimes	13
D. rarely	11
E. never	1
No response	(1)

36. The requirement to make a minimum score on each Progress Check

A. was good for me, because I knew I had to learn all the material eventually.	35
B. was of no benefit to me because I didn't study any harder, I just waited until I passed by check.	8
C. interferred with my learning because I was concerned about passing tests on past material.	11
D. made no difference to me.	25
No response	(2)

APPENDIX E

BACKGROUND VARIABLES

AND RESPONSE STATISTICS

Background variables, performance scores, and questionnaire responses by student.

Correlation table, background variables and final exam score.

Self-paced students summary statistics, background variables and final exam.

Conventional students summary statistics, background variables.

Statistically significant chi square.

BACKGROUND VARIABLES, PERFORMANCE SCORES, AND QUESTIONNAIRE RESPONSES BY STUDENT

	ID	SAT VERB	SAT MATH	ENG COMP	MATH ACH	QPR	RAW SCORE PHYS	RAW SCORE FINAL	SUB 1	SUB 2	QUESTION RESPONSE (5 = A, ..., 1 = E, 0 = Blank)
T O M	154	578	692	592	689	351	19	33	20	16	4 4 3 4 5 2 3 2 1 4 2 1 2 4 2 5 1 2 2 2 1 1 2 3 3 2 4 5 3 1 5 4 4 1 5 5
WARD F	1624	650	651	504	612	314	27	39	24	21	5 3 3 5 3 3 2 4 4 3 2 2 3 4 3 4 4 3 5 3 5 2 5 3 4 2 5 4 4 4 4 3 5 3 4 3
ES A	4326	609	550	575	565	206	0	26	15	12	3 2 2 4 4 4 2 1 2 1 2 1 1 4 4 3 4 3 3 2 3 3 2 3 5 2 5 1 4 3 3 5 2 2 4 2
EPHEN C	4410	722	800	714	800	400	0	32	20	15	4 3 3 4 5 3 3 3 3 2 4 3 3 4 3 3 4 3 2 3 4 3 3 5 5 2 5 4 1 3 3 3 1 2 4 5
ERT F	4704	702	634	708	718	266	31	25	15	13	4 3 3 4 5 4 3 2 4 3 4 3 2 2 3 4 2 4 4 3 4 2 3 4 4 1 2 4 5 3 3 5 1 2 3 5
ARD C	4795	532	536	537	665	223	19	23	12	9	4 4 3 4 4 3 2 3 2 3 4 2 3 3 3 4 2 3 2 2 3 3 4 3 3 2 4 1 5 3 3 5 4 2 2 5
G E	4830	532	727	526	708	308	30	32	19	15	1 2 3 5 4 3 3 2 4 3 4 3 2 4 2 4 3 2 2 3 2 2 3 5 4 2 5 4 3 1 4 3 4 2 3 5
G C	5110	617	572	642	535	221	24	17	8	9	3 3 3 5 3 3 3 4 3 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 5 2 4 3 1 3 3 5 1 3 2
VEN C	7042	550	653	587	561	233	29	26	17	11	4 3 3 4 4 3 3 3 4 3 4 3 4 4 3 4 4 4 4 3 4 4 4 3 4 4 2 5 1 3 3 5 5 3 5 5
ES C	8358	569	712	671	707	186	41	26	15	12	4 4 5 4 5 5 3 3 3 2 4 3 4 4 4 3 5 3 3 4 4 4 3 3 5 2 4 5 1 3 4 5 5 2 3 5
HENRY F	8799	659	728	665	665	306	36	43	25	20	4 3 3 4 5 4 3 2 4 3 4 4 5 3 4 4 5 3 2 3 2 2 4 5 1 2 4 5 3 1 5 5 4 2 4 3
HARD P	8974	584	662	604	679	191	31	25	16	11	2 4 3 5 5 2 3 4 2 2 2 2 3 4 3 5 2 2 3 3 3 2 4 4 5 4 2 5 1 3 3 3 1 1 5 5
CHARD E	9142	539	594	504	615	247	11	22	12	12	4 2 3 4 4 2 2 3 2 3 2 2 3 3 2 5 3 3 3 2 4 3 3 4 5 4 5 2 3 1 3 3 4 2 4 5
E	9044	649	724	596	693	0	0	23	10	14	3 2 2 4 2 2 3 2 2 2 3 5 2 2 2 4 4 2 2 3 4 3 3 4 4 4 2 1 5 3 2 5 1 1 3 3
OBERT F	9464	545	670	586	660	240	31	21	13	12	4 2 4 4 5 4 3 2 3 2 4 2 2 2 4 4 3 4 4 3 4 4 3 4 5 2 5 4 3 1 4 5 4 4 4 5
HN D	9660	611	682	664	679	263	21	28	18	13	5 4 4 4 5 4 3 3 4 3 4 3 5 4 3 5 4 4 4 3 3 4 3 3 2 2 5 1 3 4 3 5 2 2 1 5
D C	9723	657	765	613	717	231	37	30	15	14	4 4 3 4 4 4 3 3 4 2 4 3 2 5 4 2 4 2 2 3 2 2 3 3 3 2 5 4 1 3 3 5 5 1 3 2
LD C	980	673	701	581	631	197	21	19	9	9	4 3 3 4 2 2 2 1 1 4 1 2 2 2 2 4 1 3 2 1 3 3 4 4 5 4 2 1 5 3 5 3 5 1 5 4
EN C	3374	598	646	575	636	276	0	30	17	13	4 3 3 4 4 3 2 2 2 4 2 2 1 2 3 4 3 3 3 2 4 3 4 4 5 4 5 2 1 3 3 5 4 2 4 2
MOND M	3465	608	703	598	612	217	24	22	12	13	2 4 3 4 2 3 2 2 1 4 1 2 2 3 2 4 3 0 0 2 2 2 4 3 2 4 2 3 5 1 3 4 0 2 4 2
C B	3689	749	737	751	718	319	39	38	21	18	4 4 4 4 5 3 3 2 1 4 2 1 1 5 3 3 3 0 0 1 1 1 4 2 4 4 2 5 3 1 3 3 4 4 5 2
LLIAM C	4690	556	637	556	571	286	21	27	17	12	5 2 3 4 5 4 2 2 3 3 3 2 3 2 2 4 3 3 3 2 4 4 2 4 4 2 1 4 5 3 5 4 1 2 5 5
GARY D	4844	565	701	618	720	303	27	28	17	13	4 4 4 4 5 3 2 1 2 4 3 4 1 4 2 5 4 2 3 2 3 2 3 3 5 2 4 5 1 3 3 4 5 1 2 3
L	5572	506	673	568	698	233	30	28	14	11	4 3 3 4 5 2 3 3 2 2 4 2 2 4 3 5 2 4 3 2 4 3 2 3 4 1 5 4 2 3 5 3 1 3 4 3
A	5684	623	568	598	642	243	20	21	12	10	3 3 3 4 4 3 3 1 2 5 2 2 2 1 4 3 4 2 2 2 1 1 4 5 4 2 5 1 4 3 2 3 5 2 4 4
A	6251	696	764	684	754	0	0	31	16	11	4 3 3 4 5 3 3 0 3 3 3 3 3 4 3 4 3 4 3 2 4 5 2 3 4 5 4 2 1 3 3 4 1 3 4 2
T	7007	584	646	581	655	236	31	20	9	9	4 3 3 4 4 4 3 3 4 3 4 3 3 2 4 4 5 3 1 1 3 4 4 3 5 2 4 1 5 3 3 5 3 2 4 5
JAMES A	1085	637	671	637	708	374	17	41	23	21	4 3 3 4 5 3 3 2 2 4 2 1 2 3 3 4 3 3 3 1 3 3 3 4 5 2 5 4 1 3 3 4 4 3 5 2
FREY W	1694	715	746	703	698	394	31	47	29	23	2 4 3 4 4 3 3 2 2 4 2 2 3 4 3 4 3 3 3 1 3 3 4 4 5 2 5 4 1 3 4 3 4 2 4 3
AMES V	3003	538	600	639	563	203	27	26	15	12	4 2 3 4 5 4 3 3 3 2 3 3 3 4 3 2 4 1 1 1 2 2 2 4 4 5 2 4 1 3 5 5 4 2 5 5
HN C	3514	625	632	666	702	383	26	36	22	15	4 2 3 4 5 2 3 2 1 5 2 1 2 2 1 2 1 3 2 2 3 4 3 5 5 5 1 4 3 2 4 4 1 3 5 2
CHAEL J	3521	487	575	500	654	338	27	31	18	13	4 3 3 4 5 2 3 1 2 4 2 2 2 1 3 4 3 2 2 2 3 3 2 5 5 4 2 1 3 5 5 5 1 1 5 2
DAVID L	3829	546	606	465	510	214	26	40	24	21	4 4 4 4 5 4 3 3 3 2 4 3 4 4 3 3 4 3 3 3 4 3 3 4 4 5 4 2 3 1 4 5 1 3 4 5
HN R	4669	611	646	498	666	283	21	24	12	12	4 4 4 5 4 2 2 2 2 4 3 4 2 3 4 5 4 3 3 3 3 3 3 3 4 2 5 1 4 3 3 5 1 3 3 4
CY E	4788	537	614	452	620	247	30	25	15	9	5 4 3 5 5 3 3 4 2 3 4 3 2 2 4 4 4 5 3 2 3 4 2 3 5 5 2 4 1 3 3 5 5 4 2 2
DAVID W	5516	512	643	543	731	232	27	34	20	18	4 3 3 4 4 4 4 3 2 2 3 3 2 2 2 2 3 4 2 3 3 3 4 2 4 5 2 1 3 4 2 3 1 4 2 2
EY L	6986	637	652	565	649	327	20	32	19	11	4 4 3 4 5 4 3 3 2 3 3 3 4 4 4 4 5 3 3 1 3 3 3 4 3 2 4 5 3 1 3 5 4 4 4 5
MES C	7210	466	609	548	642	336	16	34	20	14	4 3 3 4 4 3 2 3 4 3 2 3 3 2 5 4 4 3 3 2 4 4 3 4 5 2 5 4 1 3 4 3 1 2 4 3
ONALD L	7924	539	592	560	620	262	39	32	15	15	5 4 4 4 5 3 3 2 2 2 3 2 2 3 2 4 2 0 0 1 3 3 3 3 4 5 2 1 0 0 3 5 1 0 5 2
ID L	8267	617	615	732	665	257	0	33	18	14	4 3 5 5 5 4 3 3 3 2 3 2 3 4 4 4 4 3 3 1 4 4 3 3 4 2 5 4 1 3 3 3 4 2 4 5
AUL A	8533	641	623	500	587	362	23	33	21	17	3 3 1 5 3 3 2 2 1 3 3 2 3 4 4 3 3 4 3 2 3 3 3 4 2 3 4 2 3 4 3 5 2 2 2 4

BACKGROUND VARIABLES, PERFORMANCE SCORES, AND QUESTIONNAIRE RESPONSES BY STUDENT

	ID	SAT VERB	SAT MATH	ENG COMP	MATH ACH	QPR	RAW SCORE PHYS	RAW SCORE FINAL	SUB 1	SUB 2	QUESTION RESPONSE (5 = A, ..., 1 = E, 0 = Blank)
)WARD B	9450	641	663	556	592	265	0	22	10	12	3 4 3 5 5 3 3 3 3 3 3 3 3 4 4 4 2 0 0 1 3 0 3 2 2 5 2 4 0 0 4 5 0 0 2 0
JOSEPH W	2191	484	673	447	731	274	27	33	22	12	3 3 3 4 4 4 2 2 3 4 3 3 2 1 4 3 3 3 3 2 2 2 3 5 5 5 2 4 3 1 5 4 5 1 5 3
3IN L	2394	604	646	586	709	271	13	25	11	16	4 4 4 4 5 4 3 3 4 2 4 3 4 4 4 2 4 3 3 1 3 3 3 4 3 2 5 4 3 1 3 5 4 3 2 2
3RUCE R	3052	590	635	650	642	289	13	37	20	17	4 3 4 4 4 4 3 2 3 3 2 2 3 4 4 3 4 4 3 2 2 2 4 3 4 2 4 5 3 1 3 5 5 3 4 5
3ON P B	3710	650	746	650	800	310	30	34	18	19	4 3 4 4 5 4 3 3 2 3 3 2 2 4 5 3 5 3 3 2 2 4 3 3 5 2 1 5 3 4 3 5 5 2 2 5
JGLAS G	3731	610	671	593	746	365	41	41	20	18	4 4 3 4 5 4 3 3 2 3 4 3 4 4 3 4 4 3 3 3 3 5 3 3 4 1 4 5 2 5 5 5 1 3 4 2
JGLAS E	4319	715	756	705	762	303	39	38	20	19	4 3 3 5 5 5 3 4 4 3 4 3 2 5 4 2 4 0 0 1 4 0 3 3 2 2 5 3 4 0 3 3 1 4 3 4
1ARK W	4816	505	800	629	800	350	31	34	20	18	4 4 4 5 4 3 3 3 3 3 4 4 3 4 3 4 4 2 2 2 3 3 3 3 4 5 2 4 1 3 3 3 4 2 3 2
R S	4886	604	664	574	634	244	19	32	19	15	4 4 4 4 5 4 3 4 4 3 3 3 4 4 5 4 5 3 3 2 4 3 3 3 4 2 5 1 4 3 2 3 1 3 2 2
JATHAN T	5425	650	736	665	713	291	17	35	19	15	4 3 4 4 5 5 3 3 3 1 5 3 4 3 4 3 4 3 2 2 5 3 2 4 4 2 5 1 4 3 3 5 1 1 4 5
PETER W	5579	618	596	532	657	274	20	18	12	9	5 4 3 5 5 3 3 2 2 3 2 4 3 2 3 4 4 3 3 1 3 3 3 4 5 4 5 2 3 1 3 5 4 1 5 5
)BERT B	5908	590	774	526	747	244	21	29	16	13	4 4 3 4 4 3 3 4 4 3 5 3 3 3 5 3 5 3 3 1 3 3 3 2 5 2 4 1 3 5 2 5 4 3 2 2
/EN R	6027	512	577	570	583	219	13	24	14	12	4 4 3 4 5 4 3 2 4 1 5 4 5 4 4 4 3 3 3 1 3 5 2 4 5 2 4 5 1 3 3 5 4 3 5 5
/	6181	699	767	648	800	0	0	46	25	21	4 5 3 4 5 4 3 2 4 3 2 2 2 4 3 4 5 1 1 1 1 1 4 3 4 2 5 4 3 1 3 3 4 4 4 2
:K R	6839	551	680	520	621	300	41	28	18	11	5 4 4 4 5 3 3 3 2 3 2 1 2 3 3 4 4 3 3 1 3 3 4 3 5 4 2 5 1 3 3 3 4 2 5 5
AVID D	9135	715	709	762	707	380	0	46	25	20	5 4 4 4 5 3 3 3 4 4 4 5 3 3 4 3 4 5 3 5 3 1 5 4 4 2 4 5 3 1 3 5 5 3 4 5
JIE W	1463	512	637	548	689	269	37	32	15	17	4 3 3 4 5 3 3 3 4 2 4 3 3 4 4 5 4 0 0 1 0 0 3 3 4 2 4 5 3 1 3 3 4 3 4 5
:K A	1610	569	752	514	707	374	37	26	13	12	2 4 2 5 4 3 3 1 2 4 3 2 1 3 3 3 1 3 3 1 3 3 4 4 5 5 4 2 3 1 2 5 5 1 5 5
JCE P	2485	558	692	476	631	253	19	21	13	11	2 3 3 4 5 3 3 2 2 2 4 3 3 4 3 4 4 4 4 3 3 4 3 4 5 4 2 3 5 1 2 5 4 4 4 5
AMES S	3381	585	627	543	613	291	21	28	18	14	4 3 3 4 4 4 3 2 2 4 3 1 2 3 2 4 2 3 3 1 3 3 3 4 5 5 4 5 4 5 5 3 4 1 2 2
ISSELL E	3542	564	669	666	676	342	20	37	20	16	1 4 2 4 2 2 3 1 1 5 2 2 2 2 2 5 2 2 2 2 2 2 2 4 5 5 2 4 3 1 3 4 2 1 4 3
. F J'	4739	584	646	562	631	231	13	24	13	14	1 3 3 4 5 4 3 1 1 4 2 1 2 5 3 4 4 3 2 1 2 2 1 3 5 4 5 2 1 2 2 3 4 1 5 2
A D	5887	577	652	642	642	277	31	42	25	19	4 4 4 3 4 3 3 2 4 1 4 3 4 4 3 3 2 3 3 2 3 3 3 4 3 2 5 5 3 1 3 5 4 3 5 5
I W C	7763	604	701	623	742	289	26	24	16	11	5 4 3 4 5 3 3 3 3 2 4 4 4 3 3 4 5 3 3 2 5 3 4 3 4 2 1 4 3 5 3 5 1 3 3.5
MOTHY. E	7805	530	692	559	665	303	27	23	13	11	4 4 3 4 5 4 3 4 3 3 4 3 5 4 4 3 4 3 1 1 3 3 4 4 5 2 5 4 3 1 3 5 4 3 5 5
IARLES R	8904	591	618	520	612	289	33	39	22	18	3 4 3 4 4 2 3 2 2 4 2 1 3 4 3 4 2 1 2 1 2 2 2 4 5 5 4 2 3 1 3 3 4 0 0 0
IHN M	8946	608	701	587	612	192	23	20	11	7	3 3 4 4 5 3 3 2 2 4 2 1 2 2 2 5 4 4 3 2 1 1 4 4 5 4 2 5 3 1 5 5 4 3 3 3
ARK B	1274	604	738	475	710	328	19	30	17	12	4 4 2 4 4 3 2 2 1 3 3 4 4 2 2 4 3 3 3 2 3 2 3 5 5 2 4 5 1 3 3 5 4 3 3 4
AMES H	1330	637	572	623	665	322	33	35	18	20	5 4 1 4 5 2 3 2 0 3 3 4 3 2 3 4 3 3 4 3 3 4 3 4 5 4 2 5 3 1 5 5 5 1 5 4
F D	2499	591	572	598	592	226	36	32	16	16	4 3 4 4 4 3 3 3 4 2 4 3 5 2 4 4 3 1 3 2 5 5 3 4 4 2 5 4 1 3 3 5 4 1 4 2
OHN L	2632	512	627	460	621	285	10	26	16	12	4 3 3 4 3 1 2 1 1 5 1 1 2 2 1 5 1 4 3 3 1 2 4 3 5 4 5 3 2 1 5 3 4 2 5 1
L E	3395	471	634	514	602	279	27	31	19	15	4 3 3 4 4 3 2 2 3 3 3 3 2 3 2 5 4 3 2 2 2 3 2 3 5 4 5 2 1 3 5 5 1 1 4 4
LEN R	3430	538	737	598	699	239	0	24	10	10	4 4 4 5 5 3 3 2 2 4 4 2 1 3 4 3 3 2 2 2 4 3 3 2 5 4 2 5 3 1 5 3 4 1 4 2
D L	3759	597	719	562	753	241	44	31	14	16	1 3 4 5 5 1 4 3 1 5 4 3 3 2 2 4 3 3 2 4 1 1 2 5 5 4 5 2 3 1 4 4 3 1 5 5
LLIAM B	5103	500	614	543	573	350	30	27	15	12	4 3 3 3 4 3 3 3 2 4 4 2 4 3 2 5 5 1 3 1 3 3 4 5 5 2 4 1 2 5 4 5 4 3 5 5
AVID M	5145	611	765	598	718	333	37	36	21	18	5 4 4 4 4 3 3 4 3 3 3 3 3 3 4 3 3 3 4 4 4 4 4 3 3 5 4 3 5 2 1 3 5 1 3 3 5
NNIS J	6622	551	596	498	641	232	11	26	16	14	3 5 3 4 3 3 3 2 2 2 3 3 2 4 4 4 4 3 2 3 3 5 4 3 5 4 2 5 1 3 5 5 1 1 4 2
S E	7021	690	710	675	650	283	34	32	14	15	4 4 4 4 2 3 3 3 3 4 2 2 3 4 3 4 4 4 5 3 5 5 3 2 5 1 2 3 4 5 5 5 1 2 4 2
RL A	7070	546	668	550	612	238	13	30	15	14	1 3 2 3 2 2 2 1 1 5 2 1 2 2 2 1 3 3 2 2 2 3 1 4 5 4 2 1 5 3 3 4 1 2 5 3
TEVEN M	7434	525	655	454	660	272	26	28	17	13	5 3 3 4 5 3 3 3 3 3 4 4 3 3 3 4 4 3 3 3 3 3 3 4 5 2 4 5 1 3 3 5 4 2 4 5
DANA L	9128	617	646	609	641	247	34	20	12	8	4 4 3 4 5 4 3 2 4 2 4 3 5 3 4 3 5 4 4 3 4 4 3 5 5 2 4 1 5 3 4 5 1 3 5 5

592

5 10 15 20 25 30 35

CORRELATION TABLE
BACKGROUND VARIABLES AND FINAL EXAM SCORE

	SAT Verbal	SAT Math	Eng. Comp.	Math Achiev.	QPR	Raw Score Physics	Final Exam	Final Exam Sub. 1	Final Exam Sub. 2
SAT Verbal	1.000	.407	.654	.326	.249	.198	.286	.190	.240
SAT Math		1.000	.349	.701	.321	.322	.277	.213	.241
Eng. Comp.			1.000	.389	.199	.280	.334	.226	.300
Math Achiev.				1.000	.405	.285	.328	.237	.284
QPR					1.000	.096	.595	.595	.507
Raw Score Physics						1.000	.272	.159	.220
Final Exam							1.000	.920	.884
Final Exam Sub. 1								1.000	-
Final Exam Sub. 2									1.000

SELF-PACED STUDENTS SUMMARY STATISTICS
BACKGROUND VARIABLES AND FINAL EXAM

	SAT Verbal	SAT Math	Eng. Comp.
COUNT	82	82	82
SUM	48581.000	54685.000	48016.000
SUMSQ	29109024.000	36771888.000	28543200.000
AVG	592.451	666.890	585.561
VAR	4038.914	3740.839	5270.715
STDEV	63.552	61.162	72.600
MAX	749.000	800.000	762.000
MIN	466.000	536.000	447.000
RANGE	283.000	264.000	315.000

	Math Achiev.	QPR	Raw Score Physics
COUNT	82	79	72
SUM	54521.000	22072.000	1896.000
SUMSQ	36566176.000	6384878.000	54985.867
AVG	664.890	279.392	26.333
VAR	3987.284	2796.590	71.238
STDEV	62.428	52.883	8.440
MAX	800.000	400.000	44.000
MIN	510.000	186.000	10.000
RANGE	290.000	214.000	34.000

SELF-PACED STUDENTS SUMMARY STATISTICS
BACKGROUND VARIABLES AND FINAL EXAM
(Continued)

	Final Exam	Final Exam Sub. 1	Final Exam Sub. 2
COUNT	82	82	82
SUM	2449.000	1377.000	1154.000
SUMSQ	76992.500	24650.840	17273.809
AVG	29.866	16.793	14.073
VAR	47.545	18.856	12.758
STDEV	6.895	4.342	3.572
MAX	47.000	29.000	23.000
MIN	17.000	8.000	7.000
RANGE	30.000	21.000	16.000

CONVENTIONAL STUDENTS SUMMARY STATISTICS
BACKGROUND VARIABLES

	SAT Verbal	SAT Math	Eng. Comp.	Math Achiev.	QPR	Raw Score Physics
COUNT	111	111	111	111	108	6
SUM	63284.000	74068.000	62261.000	72999.000	29184.000	120.000
SUMSQ	36483232.000	49772288.000	35328704.000	48442832.000	8165378.000	2519.999
AVG	570.126	667.279	560.910	657.648	270.222	20.000
VAR	3667.054	3166.400	3690.036	3956.364	2609.514	24.000
STDEV	60.556	56.271	60.746	62.900	51.083	4.899
MAX	701.000	792.000	703.000	800.000	400.000	27.000
MIN	433.000	563.000	437.000	515.000	168.000	14.000
RANGE	268.000	229.000	266.000	285.000	232.000	13.000

The following pages present a compilation of chi square test results that were found to be statistically significant.

The variable before the slash (/) is the primary sort variable used to select students for the statistical test; i.e., low SAT V would indicate that those students whose SAT Verbal score was below average SAT V were included in the test.

The first variable after the slash is the secondary sort variable. Students satisfying the first constraint were assigned to columns based on the secondary sort variable. If question 14 were the secondary sort variable, students who scored an A or a B were assigned to column 1, those who scored a C were assigned to column 2, and those who scored a D or an E were assigned to column 3. When the secondary sort variable was a performance variable, column 1 corresponds to below average and column 2 corresponds to above average.

The third sort variable defines the row assignment of each student. Where high, medium, and low did not constitute a valid breakdown (e.g., question 30), the matrix elements were not combined.

Example: If we had low SAT V/question 14 × question 22, the first row in column 1 would be the number of students whose SAT V was low and who scored A or B for question 14 and A or B for question 22.

GROUP A: QUESTION 14

All students/Q14 x Q6

18	4	6
17	14	8
4	2	9

alpha = .01

All students/Q14 x Q22

12	1	8
12	16	7
12	3	8

alpha = .01

High SAT M/Q14 x Q6

8	2	2
10	8	2
2	0	5

alpha = .01

High SAT M/Q14 x Q22

8	0	1
5	7	3
6	3	5

alpha = .05

High Math ach/Q14 x Q6

10	2	3
9	7	1
3	1	5

alpha = .05

Low SAT M/Q14 x Q22

4	1	7
7	9	4
6	0	3

alpha = .05

High Math ach/Q14 x Q22

7	0	2
6	8	2
7	2	5

alpha = .05

GROUP A: QUESTION 14 (continued)

High SAT V/Q14 x Q6

11	3	1
9	5	5
0	1	5

alpha = .01

Low SAT V/Q14 x Q22

5	0	6
5	11	3
8	0	3

alpha = .01

High Eng Comp/Q14 x Q6

11	3	2
10	6	3
2	0	4

alpha = .05

Low Eng Comp/Q14 x Q22

3	0	4
7	11	6
4	0	4

alpha = .05

High QPR/Q14 x Q6

6	3	1
10	6	2
2	1	5

alpha = .05

High QPR/Q14 x Q22

4	0	4
6	8	1
7	2	3

alpha = .05

Low raw phys/Q14 x Q6

8	2	1
3	7	5
1	2	5

alpha = .05

Low raw phys/Q14 x Q22

4	0	3
5	10	3
3	1	5

alpha = .05

GROUP B: QUESTION 24

Low SAT V/Q24 x Q30

3	0	1
0	0	1
8	11	0
0	1	0
11	4	1

alpha = .01

Low SAT M/Q24 x Q30

3	0	0
1	1	1
11	10	0
1	1	0
8	4	0

alpha = .05

Low Eng Comp/Q24 x Q30

3	0	1
1	1	1
8	10	0
0	1	0
11	2	0

alpha = .01

Low QPR/Q24 x Q30

0	0	1
0	1	1
11	12	0
0	1	0
10	3	1

alpha = .01

Low Math ach/Q24 x Q26

4	3	1
8	7	0
1	0	0
11	5	0
0	0	1

alpha = .01

GROUP C: MEDIA RELATED SUBTEST

All students/media related x Q30

4	3
0	5
26	10
1	1
14	15

alpha = .05

Low SAT M/media related x Q30

1	2
0	3
17	4
1	1
6	6

alpha = .05

Low raw phys/media related x Q26

1	4
10	0
0	1
10	8
0	0

alpha = .05

GROUP D: FINAL EXAM

Low Eng Comp/final x Q30

3	1
0	3
15	3
1	0
6	7

alpha = .05

High raw phys/final x Q30

1	3
0	3
12	4
0	0
3	10

alpha = .05

GROUP E: CORE PROBLEM SUBTEST

All students/core x Q30

5	2
1	4
28	8
1	1
13	16

alpha = .05

Low SAT M/core x Q30

3	0
0	3
18	3
1	1
5	7

alpha = .01

Low Eng Comp/core x Q30

4	0
0	3
16	2
1	0
8	5

alpha = .01